RAPID

Version 4

Computer Programs for Examining the Socioeconomic Impacts of Population Growth

Spectrum System of
Policy Models

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Table of Contents

I. Introduction

A. Description of the Spectrum System

1. Components

The POLICY Project and its predecessor projects have developed computer models that analyze existing information to determine the future consequences of today's population programs and policies. The new Spectrum Policy Modeling System consolidates previous models into an integrated package containing the following components:

Spectrum consolidates DemProj, FamPlan, Benefit-Cost, AIM, and RAPID models into an integrated package.

- **Demography (DemProj)** – A program to make population projections based on (1) the current population, and (2) fertility, mortality, and migration rates for a country or region.

- **Family Planning (FamPlan)** – A program to project family planning requirements in order for consumers and/or nations to reach their goals of contraceptive practice or desired fertility.

- **Benefit-Cost** – A program for comparing the costs of implementing family planning programs, along with the benefits generated by those programs.

- **AIDS (AIDS Impact Model** – AIM) – A program to project the consequences of the AIDS epidemic.

- **Socioeconomic Impacts of High Fertility and Population Growth (RAPID)** – A program to project the social and economic consequences of high fertility and rapid population growth for sectors such as labor force, education, health, urbanization and agriculture.

2. Software Description

Spectrum is a Windows-based system of integrated policy models. The integration is based on DemProj, which is used to create the population projections that support many of the calculations in the other components—FamPlan, Cost-Benefit, AIM, and RAPID.

Each component has a similarly functioning interface which is easy to learn and to use. With little guidance, anyone who has basic familiarity with Windows software will readily be able to navigate the models to create population projections and to estimate resource and infrastructure requirements. The accompanying manuals contain both instructions for users, and equations for persons who want to know exactly how the underlying calculations are computed.

B. Uses of Spectrum Policy Models

Policy models are designed to answer a number of "what if" questions. The "what if" refers to factors that can be changed or influenced by public policy.

Policy models are designed to answer a number of "what if" questions relevant to entities as small as local providers of primary health care services and as large as international development assistance agencies. The "what if" refers to factors that can be changed or influenced by public policy.

Models are commonly computerized when analysts need to see the likely result of two or more forces that might be brought to bear on an outcome, such as a population's illness level or its degree of urbanization. Whenever at least three variables are involved (such as two forces and one outcome), a computerized model can both reduce the burden of manipulating those variables and present the results in an accessible way.

Some of the policy issues commonly addressed by the Spectrum set of models include:

- the utility of taking actions earlier rather than later. Modeling shows that little in a country stands still while policy decisions are stalled and that many negative outcomes can accumulate during a period of policy stasis.

- the evaluation of the costs vs. the benefits of a course of actions. Modeling can show the economic efficiency of a set of actions (i.e., whether certain outcomes are achieved more effectively than under a different set of actions), or simply whether the cost of a single set of actions is acceptable for the benefits gained.

- the recognition of inter-relatedness. Modeling can show how making a change in one area of population dynamics (such as migration rates) may necessitate changes in a number of other areas (such as marriage rates, timing of childbearing, etc.).

- the need to discard monolithic explanations and policy initiatives. Modeling can demonstrate that simplistic explanations may bear little relationship to how the "real world" operates.

- the utility of "door openers." A set of policies under consideration may not be acceptable to all stakeholders. Modeling can concentrate on favored goals and objectives and demonstrate how they are assisted by the proposed policies.

- that few things in life operate in a linear fashion. A straight line rarely describes social or physical behavior. Most particularly, population growth, being exponential, is so far from linear that its results are startling. Modeling shows that all social sectors based on the size of population groups are heavily influenced by the exponential nature of growth over time.

- that a population's composition greatly influences its needs and its well being. How a population is composed—in terms of its age and sex distribution—has broad-ranging consequences for social welfare, crime rates, disease transmission, political stability, etc. Modeling demonstrates the degree to which a change in age and sex distribution can affect a range of social indicators.

- the effort required to "swim against the current." A number of factors can make the success of a particular program harder to achieve; for example, the waning of breastfeeding in a population increases the need for contraceptive coverage. Modeling can illustrate the need for extra effort—even if simply to keep running in place.

C. Organization of the Model Manuals

Each manual begins with a discussion of what the model does and why someone would want to use it. The manual also explains the data decisions and assumptions needed before the model can be run, and possible sources for the data. It defines the data inputs and outputs. The manual contains a tutorial, information on methodology behind the model, a glossary, and a bibliography.

D. Information about the POLICY Project

The POLICY Project is a USAID-funded activity designed to create a supportive environment for family planning and reproductive health programs through the promotion of a participatory process and population policies that respond to client needs. To achieve its purpose, the Project addresses the full range of policies that support the expansion of family planning and other reproductive health services, including:

- national policies as expressed in laws and in official statements and documents;

- operational policies that govern the provision of services;

- policies affecting gender roles and the status of women; and

- policies in related sectors, such as health, education and the environment that affect populations.

The POLICY Project is implemented by The Futures Group International in collaboration with Research Triangle Institute (RTI) and the Centre for Development and Population Activities (CEDPA).

More information about the Spectrum System of Policy Models and the POLICY Project are available from:

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E. What is RAPID?

The socioeconomic impacts model in Spectrum, known as RAPID, is a computer program for making projections of social and economic indicators for countries or regions. The program requires information on various social and economic indicators, such as the labor force participation rate, the primary enrollment rate, and the number of nurses per capita, to name a few. This information is then combined with population projections (created in the DemProj module of Spectrum) to project the future requirements of the indicators for as much as 50 years into the future.

The RAPID model is intended to provide projections that can be used as the basis of a policy presentation to stimulate policy dialogue about the importance of population factors to social and economic development.[1] Such presentations are usually intended to increase policymakers' awareness of population factors in order to improve the policy environment for effective population programs. As a result, RAPID presentations are designed to convey key information to policymakers in a form appropriate for them.

The entire process of developing a RAPID presentation requires a number of steps, including identifying key audiences and messages, collecting socioeconomic development data, making projections, preparing and testing a presentation, developing a booklet to accompany the presentation, training presenters, developing and implementing a dissemination plan, and monitoring and evaluating results.

A typical RAPID presentation includes sections on demographic background, population projections, social and economic impacts, and population program options. RAPID presentations typically examine socioeconomic impacts in education, economy, labor force and new job requirements, health, urbanization, agriculture, and the environment and natural resources. However, presentations must be tailored to each country situation. Therefore, some applications will include additional special sections such as migration, fuel wood, deforestation, water use, land degradation, etc.

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[1]We note, however, that there is much more to a successful policy dialogue activity than just the application of the RAPID model.

RAPID stands for Resources for the Awareness of Population Impacts on Development. The RAPID model was originally developed in 1978 under a contract funded by USAID (RAPID I). Both the model and the presentations have been continuously updated and improved since then. Presentations based on the RAPID model have been made to cabinet-level officials in over 40 countries, including 15 heads of state. The capability to develop and disseminate RAPID presentations has been institutionalized in a number of countries. In many of these countries, continuous dissemination activities have brought information about population programs to thousands of influential individuals at the national and local levels.

RAPID (and the entire Spectrum system of models) is designed to produce information useful for policy formulation and dialogue within a framework of computer programs that are easy to use. The focus is on generating information useful for policy and planning purposes rather than on carrying out detailed research into the underlying processes involved. For this reason, RAPID uses data that are readily available to policy analysts. It requires little demographic or socioeconomic expertise beyond what can be acquired by reviewing and using this manual.

F. Why Make Socioeconomic Projections?

Socioeconomic projections are useful for a variety of purposes. The RAPID model is designed to make projections that will be useful in stimulating policy dialogue and formulation. Projections can be useful at several stages in the policy process.

1. In the **problem-identification stage,** projections can demonstrate the magnitude of current problems, the likely future magnitude of these and other problems, and the effects of problems in one sector on other development sectors. These projections are used primarily to make people aware that certain problems exist.

2. In the **agenda-setting stage**, projections can be used to show the importance of particular problems in order to encourage decision makers to put the problems on the policy agenda. Problems then can be matched with other items already on the policy agenda and policymakers can be encouraged to address them.

3. In the **policy-solution stage,** projections can be used to illustrate the effectiveness of proposed solutions in order to generate a consensus around effective actions.

4. In the **policy-participation stage,** policy presentations that include projections can be used with a variety of stakeholders in order to disseminate broadly information about problems and proposed solutions. When conducted early in the process, such activities can broaden the participation in defining problems and solutions. After new policies and programs have been adopted, these activities can be used to explain the new policies and generate support for them.

Socioeconomic projections are also required for planning. All national development plans contain future estimates of a nation's needs for new jobs, teachers, schools, doctors, nurses, urban housing, food, etc. The RAPID model is not intended for preparing detailed planning projections, as it focuses on relatively simple projection techniques that are easily communicated to policymakers. Such projections do have a role in long-term planning, however.

Often, alternative socioeconomic projections are made to show how various rates of population growth would affect the projections. For example, an analysis of the impacts of population growth on education typically would include a high-growth projection (to show the magnitude of the problem under current conditions), and a low-growth projection (to show how a slower-growing population would put less pressure on the education system to meet national education goals). The RAPID model makes it easy to generate alternative projections once the basic assumptions have been agreed upon.

II. Steps in Making Socioeconomic Projections

There are nine key steps in using the RAPID model to make socioeconomic projections. The amount of time spent on each step may vary, depending on the application, but most projection activities will include at least these nine steps.

1. **Prioritization of population policy issues.** Defining the country's critical problem areas helps focus the data collection efforts and develop meaningful presentations. The RAPID module currently contains indicators for five sectors: economy, education, health, urbanization and agriculture. Within each of these sectors, however, it is important to select indicators that will be useful in planning or for highlighting potential future problem areas. For example, in Egypt, it would be appropriate to make projections about future water supply and demand. In Tanzania, the destruction of forests might be a more appropriate indicator. Additional sectors can be added to the RAPID model as required for particular applications.

2. **Select geographic area.** Socioeconomic projections are normally done at the national level. However, projections may also be done for other geographic areas such as urban areas, capital cities, provinces, districts and catchment areas. For example, the trend toward decentralization of public programs in many countries has greatly increased the need for projections at the district and provincial level. The first step in making a socioeconomic projection is to decide the most appropriate geographic area for the application.

3. **Determine the period of the projection.** Socioeconomic projections start at some base year and continue for a certain number of years into the future. The base year is often selected on the basis of data availability. The year of the most recent census or large-scale survey is normally selected for the base year of the projection. The number of years to project is determined by the use of the projection. Planning activities generally focus on short-term projections (5 years) while projections used for policy dialogue often use a longer time horizon (10-30 years).

4.   **Collect data.**   Data must be collected for each of the assumptions underlying the socioeconomic projections. Since the projections will only be as good as the data on which they are based, it is worth the effort to collect and prepare appropriate and high-quality data before starting the projection.

5.   **Make assumptions.** Socioeconomic projections require that estimates be made about the future levels of the equation's underlying assumptions.   These assumptions should be carefully considered and based on reasonable selection guidelines.

6.   **Use model.** Once the base year data are collected and decisions are made about projection assumptions, RAPID can be used to enter the data and make the socioeconomic projections.

7.   **Examine projections.** Once the projection is made, it is important to examine it carefully. Careful examination of the indicators can act as a check to ensure that the base data and assumptions were understood and were entered correctly into the computer program. This careful examination is also required to ensure that the consequences of the assumptions are fully understood.

8.   **Make alternative projections.** Many applications require alternative socioeconomic projections, as described at the end of Chapter I. Once the base projection has been made, the program can be used to quickly generate alternative projections as the result of varying one or several of the projection assumptions.

9.   **Disseminate findings.** Once the projections are made, it is important to disseminate them to policymakers. Typically, the projections form a part of a policy presentation that is used to stimulate policy dialogue about key issues. Projection results may also be disseminated through policy booklets, conference papers, and other publications.

III. Projections of Socioeconomic Impacts

This section of the manual focuses on presenting the socioeconomic indicators currently contained in the RAPID module. These indicators are broken down into five major sectors: economy, education, health, urbanization, and agriculture. While additional sectors and indicators can be added to the RAPID module, this section only considers those currently contained in the system. The general description and methodology, the equation(s), and the inputs and sources (where data underlying the assumptions might be found) are given for each indicator.

The methodology described below assumes that a population projection is available. The population projection is prepared with the DemProj model included in Spectrum. For more information on using the DemProj model to prepare population projections, see the DemProj manual (*DemProj: A Computer Program for Making Population Projections*).

Each of the sectors described here uses population projections from DemProj. This manual describes the simplest application of the RAPID model which does not include interactions between socioeconomic sectors or from these sectors back to the population projection. Such interactions may be important in some situations and can be added if needed. The figure below shows these relationships schematically.
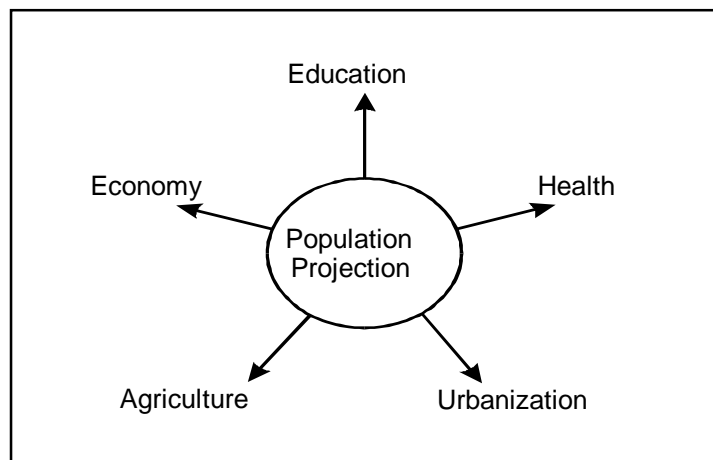
A. Economy

Introduction

Population growth may affect economic development in a variety of ways. A rapidly expanding population may stimulate demand for goods and services if incomes are also growing or may reduce per capita income if income grows at a slower pace than the population. Rapid growth of the labor force may provide the labor needed for an expanding economy or may result in more unemployment and underemployment if the rate of new job creation does not match the expansion of the labor force. Savings and investment may be reduced if a greater proportion of output is diverted to consumption to support the larger population. In short, the relationships between population growth and economic growth are many and complex.

There is a large literature on these issues and many economics texts contain extensive treatments of the linkages between population growth and economic development. Several recent studies have found that a reduced rate of population growth has played a key role in the economic development of many Asian countries, such as South Korea, Taiwan, Thailand, Singapore, Indonesia and Malaysia. Specifically, these studies have found that:

- Fertility decline slowed the growth in the number of school-aged children. By keeping educational expenditures high, these countries were able to increase enrollment rates and the quality of education received by each child.

- Savings increased as household size declined. As dependency rates declined, families were able to save more of their income. These savings replaced foreign capital as the major source of domestic investment.

- Fertility decline eventually led to slower growth in the labor force. As a result, both wages and capital investment per worker rose.

For more information on these studies see the *Proceedings of the Conference on Population and the East Asian Miracle, 7-10 January 1997*. For a good summary of recent information on economic growth and population see Cincotta and Engelman, 1997.

The effect of rapid population growth on economic growth depends on a number of factors. It has been difficult for those who study this relationship to find unambiguous connections because many of the factors that influence economic growth

vary across countries just as population growth rates do. The variety of issues that have been studied is illustrated in the following list of questions examined by the National Research Council in a 1986 study (National Research Council, 1986):

- Will slower population growth increase the growth rate of per capita income by increasing per capita availability of exhaustible resources?

- Will slower population growth lead to more capital per worker, thereby increasing per worker output and consumption?

- Do lower population densities lead to lower per capita incomes via a reduced stimulus to technological innovation and reduced exploitation of economies of scale in production and infrastructure?

- Will slower population growth decrease the degree of inequality in the distribution of income?

- Will slower population growth facilitate the absorption of workers into the modern economic sector and alleviate problems of urban growth?

None of these questions has a simple "yes" or "no" answer.

Since many of these issues are too complex to treat in a short policy presentation, the RAPID model uses only relationships that are well understood and easy to describe. The basic model focuses on three basic concepts: dependency, the requirement for new jobs, and per capita output.

Dependency: Dependency is expressed as the number of people in the labor force compared to the number of child dependents. Child dependents are children under the age of 15 who are not in the labor force. The labor force is calculated as the size of the adult population multiplied by the percent that are in the labor force. The projections generally show that the number of dependents is high compared to the labor force when the population is growing rapidly. The ratio of dependents to labor force improves (declines) as the population growth drops. This indicates that more resources are available to support each child when the population growth rate is low than when it is high.

New jobs: New job requirements are calculated as the net growth in the labor force. This includes young people entering the labor force for the first time as well as people leaving the labor force because of retirement or death. When the population is growing rapidly, the number of new jobs required each year also rises quickly. When population growths slows,

the number of new jobs required each year generally levels off or declines within 15 years. The 15-year delay occurs because changes in the number of births in one year will not affect the entrants to the labor force until they reach labor force age, about 15.

In economies where underemployment and unemployment are problems, a slower growth in the number of new jobs *required* each year may provide the opportunity for a greater proportion of the population to find productive jobs.

Gross Domestic Product (GDP) per capita: The relationship between population growth and economic growth is too complex to project with a simple model in a policy presentation. For this reason, the RAPID model only projects GDP per capita under the assumption that the growth rate of GDP is unaffected by population growth. The annual rate of GDP growth is assumed, usually based on the projected growth in the national development plan or on historical experience. Given the growth rate in GDP, the model projects future levels of GDP per capita. Clearly, in this case, a slower rate of population growth will result in a higher level of GDP per capita. This projection is used to illustrate the fact that growth in per capita income occurs only to the extent that the growth rate of GDP exceeds the growth rate of the population. In countries with high rates of population growth, it may be difficult to achieve substantial gains in per capita income.

Methodology

1. Labor Force

Description and Methodology: The size of the labor force in the future is projected by assuming that a certain percentage of the population between the ages of 10 and 64 will be in the labor force at any time.   Therefore, the future labor force size is calculated by multiplying the labor force participation rate for ages 10 to 64 by the size of the population aged 10 to 64. RAPID specifies the labor force participation rates separately for males and females and for the age groups 10-14 and 15-64. Because at any given time, the size of the labor force for the next 15 years already has been determined (i.e., the new entrants have already been born), there will usually be little variation between alternative population projections in the near term based on differing total fertility rate (TFR) assumptions. It is sometimes important to make this point to allay fears that lower fertility will result in immediate labor shortages.

Equation:

$$LaborForce_t = \sum_s (Pop_{15\text{-}64,t,s} \cdot LFPR_{15\text{-}64,t,s}) + (Pop_{10\text{-}14,t,s} \cdot LFPR_{10\text{-}14,t,s}) ,$$

where:

$LaborForce_t$	=	size of the labor force in time t
$Pop_{15\text{-}64,t,s}$	=	population of sex s aged 15-64 in time t
$LFPR_{15\text{-}64,t,s}$	=	labor force participation rate for population of sex s aged 15-64 in time t
$Pop_{10\text{-}14,t,s}$	=	population of sex s aged 10-14 in time t
$LFPR_{10\text{-}14,t,s}$	=	labor force participation rate for population of sex s aged 10-14 in time t.

Potential Sources: National labor force surveys, development plans, statistical yearbooks, International Labour Organization's (ILO) Yearbook of Labour Statistics, *World Bank's* World Development Indicators

Inputs:

Labor force participation rate, population aged 15-64

In most cases the policy presentation will be clearest if the labor force participation rate for the population 15-64 remains constant. There are cases where it will be better to project changes in the participation rate, however. For example, the participation rate may decline if enrollment rates in secondary and higher education are increasing significantly. Participation rates for females may increase if their participation in the formal labor force has been small in the past. Special circumstances might also require special assumptions (e.g., a new law requiring mandatory retirement at age 60 will be implemented over the next 10 years).

Labor force participation rate, population aged 10-14

If no data exist for the 10-14 age group, assume it is either 0 (not part of the labor force), or the same as for the population aged 15-64. The assumption regarding the future labor force participation rate for 10- to 14-year-olds should remain constant unless there is a strong rationale for modifying it (e.g., a new law requiring secondary education will be implemented over the next 10 years), and data are available to support the new assumptions.

Population projection for ages 10-64

The DemProj module supplies both the variables of the population ages 15-64 and ages 10-14.

2. Child Dependents

Description and Methodology: The number of child dependents in the future is projected by adding all the children under age 10 to those aged 10 to 14 who are not in the labor force.

Equation:

$$ChildDependents_t = Pop_{0-9,t} + [Pop_{10-14,t} \cdot (1 - LFPR_{10-14,t})] \, ,$$

where:

$Child\ Dependents_t$	=	size of the labor force in time t
$Pop_{0-9,t}$	=	population aged 0-9 in time t
$Pop_{10-14,t}$	=	population aged 10-14 in time t
$LFPR_{10-14,t}$	=	labor force participation rate for population aged 10-14 in time t.

3. New Jobs Required

Description and Methodology: The annual number of new jobs required in the future is assumed to be equivalent to the difference in the size of the labor force from one year to the next. It is calculated by subtracting the size of the previous year's labor force from the size of the current year's labor force. This is a net measure of new jobs required. It takes into account new entrants to the labor force and retirements and deaths among current workers. The number of new jobs required is an indicator of the economic growth required to maintain current employment levels. (Note: The number of new jobs required in the base year is assumed to be equivalent to the number of new jobs required in the first year of the projection.)

Equation:

$$NewJobs_t = LaborForce_t - LaborForce_{t-1} \, ,$$

$$NewJobs_1 = NewJobs_2 \, ,$$

where:

$NewJobs_t$	=	new jobs required in time t
$LaborForce_t$	=	size of the labor force in time t
$LaborForce_{t-1}$	=	size of the labor force in the previous year.

Input and Source:

Labor force size

The projection of labor force size used in the equation comes from the indicator described above.

4. Gross Domestic Product

Description and Methodology: The future gross domestic product (GDP) is calculated by assuming that GDP increases at an exogenously specified growth rate. It is not intended to be a forecast of actual GDP, but is used to demonstrate the impact of population growth on GDP per capita given constant economic growth. (Note: GDP in the base year is entered directly into the model.)

Equation:

$$GDP_t = GDP_{t-1} \cdot (1 + AnnualGDPGrowth_t) \, ,$$

where:

GDP_t	=	gross domestic product in time t
$AnnualGDPGrowth_t$	=	annual growth in gross domestic product in time t.

Inputs:

Gross domestic product (GDP) and annual growth in GDP

The future annual growth can be based on historic growth patterns in GDP (usually over a 5- to 10-year period), or on target growth patterns (e.g., specified in national 5-year plans for economic growth). In most cases, the annual growth in GDP will be similar for alternative population projections.

5. Gross Domestic Product per Capita

Description and Methodology: The future GDP per capita is calculated by dividing the projected GDP by the size of the total population. This indicator is intended not to be a forecast of actual economic performance, but rather to demonstrate the impact of population growth on personal economic well-being.

Equation:

$$GDPPerCapita_t = GDP_t / TotalPop_t \, ,$$

where:

$GDPPerCapita_t$	=	gross domestic product per person in time t
GDP_t	=	gross domestic product in time t

$$TotalPop_t \quad = \quad \text{total population in time } t.$$

Input:

Gross domestic product (GDP)

This input comes from the GDP_t indicator described above.

Total population projection

The DemProj module supplies this variable.

B. Education

Introduction

Education is one of the keys to successful development. Most countries recognize the importance of education and have adopted a goal of universal primary education. The RAPID model addresses this issue by looking at the resources required to achieve national education goals. The inputs to these projections are the enrollment rate goals (usually set out in the national development plan), the number of teachers and classrooms required per student (usually based on current ratios), and the public expenditure per student (usually based on current expenditure rates). RAPID uses these inputs to project the number of primary and secondary school students required in order to achieve the enrollment rate goals. It also projects the number of teachers and classrooms and the expenditures required. These projections are designed to show that huge increases in educational resources are required to achieve national goals when population growth rates are high. The goals are much easier to achieve when population growth rates are slower.

Methodology

1. Children of Primary School Age

Description and Methodology: The number of children of primary school age is calculated by summing all children who are of the ages to attend primary school.

Equation:

$$ChildrenPrimAge_t \quad = \quad \sum_{a=BPA}^{BPA+YrsPrimSchool-1} Pop_{a,t} \ ,$$

where:

$$ChildrenPrimAge_t \quad = \quad \text{children of primary school age in time } t$$

$$\sum_{a=BPA}^{BPA+YrsPrimSchool-1} Pop_{a,t}$$

= population at beginning primary age *(BPA)* to population at ending age *(BPA+YrsPrimSchool-1)* in time *t*

BPA	=	age at which primary school normally begins
YrsPrimSchool	=	normal number of years of primary school.

Inputs:

Beginning primary school age and number of years of primary school

If no data exist for the beginning primary school age, using 6 or 7 is a reasonable assumption. Most countries have children begin their primary school cycle at these ages. The model does not allow the beginning assumption to be modified in the future.

If no data exist for the number of years of primary school, using 6 is a reasonable assumption. Many countries have 6 years of schooling in their primary school cycle. The model does not allow the beginning assumption to be modified in the future.

Primary-school-aged population projection

The DemProj module supplies this variable.

2. Primary Students

Description and Methodology: The number of primary students is projected by multiplying the number of children of primary school age by the primary enrollment rate.

Equation:

$$PrimStudents_t = ChildrenPrimAge_t \bullet PrimEnrRate_t \, ,$$

where:

$PrimStudents_t$	=	number of primary students in time *t*
$ChildrenPrimAge_t$	=	children of primary school age in time *t*
$PrimEnrRate_t$	=	primary enrollment rate in time *t.*

Primary enrollment rate

The primary enrollment rate is equivalent to the gross enrollment rate, i.e., the total number of primary students divided by the population considered to be of primary school age. The assumption regarding the future primary enrollment rate should remain constant unless there is a strong rationale for modifying it.

Children of primary school age

The DemProj module supplies this variable.

3. Primary Teachers Required

Description and Methodology: The number of primary teachers required is projected by dividing the total number of primary students by the ratio of primary students to primary teachers.

Equation:

$$PrimTeachers_t = PrimStudents_t / StudentsPerPrimTeacher_t ,$$

where:

$PrimTeachers_t$	=	number of primary teachers in time t
$PrimStudents_t$	=	number of primary students in time t
$StudentsPerPrimTeacher_t$ =		ratio of primary students to primary teachers in time t.

Ratio of primary students to primary teachers

Ratio of primary students to primary schools

This figure can be taken directly from the sources listed, or it can be estimated by dividing the total number of primary students in a year by the total number of primary teachers in that year. The assumption regarding the future ratio of primary students to primary teachers should remain constant unless there is a strong rationale for modifying it.   In many cases, however, as governments attempt to improve their educational systems, they develop target student/teacher ratios in their development plans.   In these cases, it is useful to include the targets as assumptions to demonstrate the difficulty in achieving them with continued high rates of population growth.

4. Primary Schools Required

Description and Methodology: The number of primary schools required is projected by dividing the total number of primary students by the ratio of primary students to primary schools.

Equation:

$$PrimSchools_t = PrimStudents_t / StudentsPerPrimSchool_t,$$

where:

PrimSchools_t	=	number of primary schools in time *t*
PrimStudents_t	=	number of primary students in time *t*
StudentsPerPrimSchools_t	=	ratio of primary students to primary schools in time *t.*

Inputs and Sources:

Primary students per primary school ratio

This figure can be taken directly from the sources listed, or can be estimated by dividing the total number of primary students in a year by the total number of primary schools in that year. The assumption regarding the future ratio of primary students to primary schools should remain constant unless there is a strong rationale for modifying it.   In many cases, however, as governments attempt to improve their educational systems, they develop target student/school ratios in their development plans.   In these cases, it is useful to include the targets as assumptions to demonstrate the difficulty in achieving them with continued high rates of population growth.

5. Primary Expenditure Required

Description and Methodology: The recurrent primary education expenditure is projected by multiplying the total number of primary students by the average recurrent expenditure per primary student.   This indicator is useful in demonstrating the levels of financial resources that will be required to support the primary education system in the future.

Equation:

$$PrimExp_t = PrimStudents_t \bullet ExpPerPrimStudent_t ,$$

where:

PrimExp_t	=	recurrent primary education expenditure in time *t*

$PrimStudents_t$　　　=　number of primary students in time t

$ExpPerPrimStudent_t$　=　average recurrent primary expenditure per primary student in time t.

Inputs and Sources:

Average recurrent primary expenditure per student

This figure can be taken directly from the sources listed, or can be estimated by dividing the annual recurrent expenditure for primary education in a year by the total number of primary students in that year.   The future recurrent expenditure per primary student should remain constant unless there is a rationale for modifying it.   In many cases, however, as governments attempt to improve their educational systems, they want to increase their recurrent expenditure per student to meet specified targets.   If available, these targets can be used to demonstrate the additional financial burden associated with continued high rates of population growth.

6. Children of Secondary School Age

Description and Methodology: The number of children of secondary school age is calculated by summing all children who are of the ages to attend secondary school.

Equation:

$$ChildrenSecAge_t = \sum_{a=BSA}^{BSA+YrsSecSchool-1} Pop_{a,t} \, ,$$

where:

$ChildrenSecAge_t$ = children of secondary school age in time t

$\displaystyle\sum_{a=BSA}^{BSA+YrsSecSchool-1} Pop_{a,t}$ = population at beginning secondary age *(BSA)* to population at ending age *(BSA+YrsSecSchool-1)* in time *t*

BSA = age at which secondary school normally begins

$YrsSecSchool$ = normal number of years of secondary school.

Inputs and Sources:

Beginning secondary school age

If no data exist for the beginning secondary school age, 12 or 13 is a reasonable assumption. Most countries have children begin their secondary school cycle at these ages. The model does not allow the beginning assumption to be modified in the future.

Number of years of secondary school

If no data exist for the number of years of secondary school, 6 is a reasonable assumption; most countries have either 4 or 6 years of secondary schooling. The model does not allow the beginning assumption to be modified in the future.

Population projection for the children of secondary school age

The DemProj module supplies this variable.

7. Secondary Students

Description and Methodology: The number of secondary students is projected by multiplying the number of children of secondary school age by the secondary enrollment rate.

Equation:

$$SecStudents_t = ChildrenSecAge_t \bullet SecEnrRate_t \, ,$$

where:

$SecStudents_t$	=	number of secondary students in time t
$ChildrenSecAge_t$	=	children of secondary school age in time t
$SecEnrRate_t$	=	secondary enrollment rate in time t.

Inputs and Sources:

Secondary enrollment rate

The secondary enrollment rate is equivalent to the gross secondary enrollment rate, i.e., the total number of secondary students divided by the population considered to be of secondary school age. The assumption regarding the future secondary enrollment rate should remain constant unless there is a strong rationale for modifying it.

Children of secondary school age

The DemProj module supplies this variable.

8. Secondary Teachers Required

Description and Methodology: The number of secondary teachers required is projected by dividing the total number of secondary students by the ratio of secondary students to secondary teachers.

Equation:

$$SecTeachers_t = SecStudents_t / StudentsPerSecTeacher_t ,$$

where:

$SecTeachers_t$	=	number of secondary teachers in time t
$SecStudents_t$	=	number of secondary students in time t
$StudentsPerSecTeacher_t$	=	ratio of secondary students to secondary teachers in time t.

Inputs and Sources:

Secondary students per secondary teacher ratio

This figure can be taken directly from the sources listed, or can be estimated by dividing the total number of secondary students in a year by the total number of secondary teachers in that year.   The assumption regarding future ratios of secondary students to secondary teachers should remain constant unless there is a strong rationale for modifying it.   In many cases, however, as governments attempt to improve their secondary educational systems, they develop target student/teacher ratios in their development plans.   In these cases, it is useful to include the targets as assumptions to demonstrate the difficulty in achieving them with continued high rates of population growth.

9. Secondary Schools Required

Description and Methodology: The number of secondary schools required is projected by dividing the total number of secondary students by the ratio of secondary students to secondary schools.

Equation:

$$SecSchools_t = SecStudents_t / StudentsPerSecSchool,$$

where:

$SecSchools_t$ = number of secondary schools in time t

$SecStudents_t$ = number of secondary students in time t

$StudentsPerSecSchools_t$ = ratio of secondary students to secondary schools in time t.

Inputs and Sources:

Secondary students per secondary school ratio

This figure can be taken directly from the sources listed, or can be estimated by dividing the total number of secondary students in a year by the total number of secondary schools in that year.   The assumptions regarding future ratios of secondary students to secondary schools should remain constant unless there is a strong rationale for modifying it.   In many cases, however, as governments attempt to improve their secondary educational systems, they develop target student/school ratios in their development plans.   In these cases, it is useful to include the targets as assumptions to demonstrate the difficulty in achieving them with continued high rates of population growth.

10. Secondary Education Expenditure Required

Description and Methodology: The recurrent secondary education expenditure is projected by multiplying the total number of secondary students by the average recurrent expenditure per secondary student.   This indicator is useful in demonstrating the levels of financial resources that will be required to support the secondary education system in the future.

Equation:

$$SecExp_t = SecStudents_t \bullet ExpPerSecStudent_t ,$$

where:

$SecExp_t$	=	recurrent secondary education expenditure in time t
$SecStudents_t$	=	number of secondary students in time t
$ExpPerSecStudent_t$	=	average recurrent secondary expenditure per secondary student in time t.

Inputs and Sources:

Average recurrent secondary expenditure per student

This figure can be taken directly from the sources listed, or can be estimated by dividing the annual recurrent expenditure for secondary education in a year by the total number of secondary students in that year. The future recurrent expenditure per secondary student should remain constant unless there is a rationale for modifying it. In many cases, however, as governments attempt to improve their secondary educational systems, they want to increase their recurrent expenditure per student to meet specified targets. If available, these targets can be used to demonstrate the additional financial burden associated with continued high rates of population growth.

C. Health

Introduction

There are a number of ways that population growth affects the health status of the population. Probably the most important relationship is between high fertility and infant, child, and maternal mortality. High fertility is usually associated with short birth intervals, early age at first birth, and many higher-order births. An excellent review of these relationships is contained in *Family Planning Saves Lives* (Shane, 1997). The major conclusions of this review are:

- Closely spaced births result in higher infant and child mortality.

- Spacing births can prevent an average of one in four infant deaths.

- Children born to young mothers are more likely to die.

- Family planning can prevent at least 25 percent of all maternal deaths.

- Family planning prevents maternal deaths from unsafe abortions.

These relationships are the most important health-related issues regarding population growth. They are easily illustrated with data and charts from *Family Planning Saves Lives* and national surveys such as the Demographic and Health Survey (DHS). Most RAPID presentations should contain slides on this topic. However, since a computer model is not required to illustrate these points, they do not form a part of the RAPID module in Spectrum. Instead the model focuses on projecting the

increased resources required to maintain or improve health care. The model projects the number of doctors, nurses, health centers, hospitals, and hospital beds required to maintain current per capita ratios or to achieve future goals. It also projects the public expenditure required to maintain or improve health services. These indicators show the increased burden required in all social sectors to keep up with a rapidly expanding population.

Methodology

1. Doctors Required

Description and Methodology: The number of doctors required is projected by dividing the total population by the number of people per doctor.   This indicator is useful in demonstrating how the health sector will have to expand in the future to maintain current levels of health services, both in supporting the current number of doctors and in providing training for new doctors.   Since doctors are not the most common primary health care providers in many developing countries, the number of doctors required might not be an accurate indicator of future health service requirements.   In many cases, the number of doctors together with the number of nurses required gives a more comprehensive indication of future health service requirements.

Equation:

$$Doctors_t = TotalPop_t \, / \, PopPerDoctor_t \, ,$$

where:

$Doctors_t$	=	number of doctors in time t
$TotalPop_t$	=	total population in time t
$PopPerDoctor_t$	=	number of persons per doctor in time t.

Inputs and Sources:

Population per doctor

This figure can be taken directly from the sources listed, or can be estimated by dividing the total population in a year by the total number of doctors in that year.   The assumption regarding future population per doctor can remain constant in the future (reflecting a continuation of the current service level of the health system), or can be changed to reflect target ratios in the country's development plans.   Setting the future assumptions to reflect target ratios can be useful in demonstrating the difficulty in achieving the goals with continued high rates of population growth.

Total population projection

The DemProj module supplies this variable.

2. Nurses Required

Description and Methodology: The number of nurses required is projected by dividing the total population by the number of people per nurse.   This indicator is useful in demonstrating how the health sector will have to expand in the future to maintain current levels of health services, both in supporting the current number of nurses and in providing training for new nurses.

Equation:

$$Nurses_t = TotalPop_t / PopPerNurse_t \; ,$$

where:

$Nurses_t$ = number of nurses in time t

$TotalPop_t$ = total population in time t

$PopPerNurse_t$ = number of persons per nurse in time t.

Inputs and Sources:

Population per nurse

This figure can be taken directly from the sources listed, or can be estimated by dividing the total population in a year by the total number of nurses in that year. The assumption regarding the future population per nurse can remain constant in the future (reflecting a continuation of the current service level of the health system), or can be changed to reflect target ratios in the country's development plans.   Setting the future assumptions to reflect target ratios can be useful in demonstrating the difficulty in achieving the goals with continued high rates of population growth.

Total population projection

The DemProj module supplies this variable.

3. Health Centers Required

Description and Methodology: The number of health centers required is projected by dividing the total population by the number of people per health center. This indicator is useful in demonstrating how the health sector's infrastructure will have to expand in the future.

Equation:

$$HealthCenters_t = TotalPop_t / PopPerHealthCenter_t \ ,$$

where:

$HealthCenters_t$	=	number of health centers in time t
$TotalPop_t$	=	total population in time t
$PopPerHealthCenter_t$	=	number of persons per health center in time t.

Inputs and Sources:

Population per health center

This figure can be taken directly from the sources listed, or can be estimated by dividing the total population in a year by the total number of health centers. The assumption regarding the population per health center can remain constant in the future, or can be changed to reflect target ratios in the country's development plans. Setting the future assumptions to reflect target ratios can be useful in demonstrating the difficulty in achieving the goals with continued high rates of population growth.

Total population projection

The DemProj module supplies this variable.

4. Hospitals Required

Description and Methodology: The number of hospitals required is projected by dividing the total population by the number of people per hospital. This indicator is useful in demonstrating how the health sector's infrastructure will have to expand in the future. Since hospitals are usually restricted to urban areas, however, the number of hospitals required might not be an accurate indicator of health infrastructure

requirements.   Often, the number of hospitals together with the number of health centers required gives a more comprehensive indication of future health infrastructure requirements.

Equation:

$$Hospitals_t = TotalPop_t / PopPerHospital_t \ ,$$

where:

$Hospitals_t$ = number of hospitals in time t

$TotalPop_t$ = total population in time t

$PopPerHospital_t$ = number of persons per hospital in time t.

Inputs and Sources:

Population per hospital

The DemProj module supplies this variable.

This figure can be taken directly from the sources listed, or can be estimated by dividing the total population in a year by the total number of hospitals.   The future population per hospital assumption can remain constant in the future, or can be changed to reflect target ratios in the country's development plans.   Setting the future assumptions to reflect target ratios can be useful in demonstrating the difficulty in achieving the goals with continued high rates of population growth.

Total population projection

The DemProj module supplies this variable.

5. Hospital Beds Required

Description and Methodology: The number of hospital beds required is projected by dividing the total population by the number of people per hospital bed.   This indicator is useful in demonstrating how the health sector's infrastructure will have to expand in the future.

Equation:

$$HospitalBeds_t = TotalPop_t / PopPerHospitalBed_t \ ,$$

where:

$Hospitalbeds_t$ = number of hospital beds in time t

$TotalPop_t$ = total population in time t

$$PopPerHospitalBed_t = \text{number of persons per hospital bed in time } t.$$

Inputs and Sources:

Population per hospital bed

This figure can be taken directly from the sources listed, or can be estimated by dividing the total population in a year by the total number of hospital beds. The assumption regarding the population per hospital bed can remain constant in the future, or can be changed to reflect target ratios in the country's development plans. Setting the future assumptions to reflect target ratios can be useful in demonstrating the difficulty in achieving the goals with continued high rates of population growth.

Total population projection

The DemProj module supplies this variable.

6. Annual Recurrent Health Expenditure

Description and Methodology: The annual recurrent health expenditure is projected by multiplying the total population by the average recurrent health expenditure per person. This indicator is useful in demonstrating the financial resources required to support the health system in the future.

Equation:

$$HealthExp_t = TotalPop_t \bullet HealthExpPerPerson_t \ ,$$

where:

$HealthExp_t$ = annual recurrent health expenditure in time t

$TotalPop_t$ = total population in time t

$HealthExpPerPerson_t$ = recurrent health expenditure per person in time $t.$

Inputs and Sources:

Average recurrent health expenditure per person

This figure can be taken directly from the sources listed, or can be estimated by dividing the annual recurrent health expenditure in a year by the total population in that year. The future recurrent health expenditure per person can remain constant, or can be changed to reflect national goals for improving the health care system. As governments attempt to improve their health systems, they may want to increase their recurrent health expenditure per person. Using these targets can be helpful in demonstrating the financial burden associated with high rates of population growth.

Total population projection

The DemProj module supplies this variable.

7. Population at High Health Risk

Description and Methodology: The population at high health risk is assumed to be the total infant and child population (all persons under the age of 5), plus all females of childbearing age (between 15 and 49). These groups are considered to be highly exposed to certain typical risks associated with their age and sex. For example, children under 5 are more susceptible to disease because of their underdeveloped immune systems and poor nutritional status. Women of reproductive age are at risk because of complications associated with multiple and closely spaced pregnancies, frequently seen in countries with high fertility.

Equation:

$$HealthRiskPop_t = FemalePop_{15\text{-}49,t} + Pop_{0\text{-}4,t} \ ,$$

where:

$HealthRiskPop_t$	=	population considered to be at high risk in time t
$FemalePop_{15\text{-}49,t}$	=	female population of reproductive age (15-49) in time t
$Pop_{0\text{-}4,t}$	=	population under the age of 5 in time t.

Inputs and Sources:

Population projection for the female population aged 15-49 and the population under the age of 5

The DemProj module supplies this variable.

D. Urbanization

Introduction

As a country develops, it generally makes a transition from being largely rural to having a significant proportion of its population living in urban areas. Urbanization can be particularly rapid in countries that combine a high rate of natural population growth with high rates of rural-to-urban migration. Urbanization does offer some benefits. For example, it creates the critical mass required for airports, seaports, universities, and large factories. If urbanization takes place very rapidly, however, many city dwellers may not have access to such basic needs as clean water, sanitation, and adequate housing. Urbanization rates, wealth, and development policies all interact in complex ways to determine the living conditions of people in urban areas. However, experience has shown that rapid growth of urban populations in developing countries has generally led to significant portions of urban dwellers living in substandard conditions. The RAPID model projects the size of the total urban population and the largest cities under various conditions in order to illustrate the pace and magnitude of the urban growth problem.

Methodology

1. Total Urban Population

Description and Methodology: The total urban population is calculated directly through the DemProj module. If no urban projections were made using DemProj, the RAPID display options for the urbanization sector will not appear.

The approach used in DemProj first projects the national population and then distributes it according to region (i.e., urban or rural). It does not make a separate projection for each region. The benefit of this approach is that separate estimates of the total fertility rate (TFR), life expectancy and model life tables are not required. The disadvantage is a lack of flexibility in fully specifying the differences between the regions. If this flexibility is important, then DemProj should be used to project urban and rural regions separately.

There are two methods for developing the urban and rural projections. In the first, the analyst provides an assumption about the percentage of the total population that is urban for each year of the projection. Then rural population is simply the difference between the total and urban populations.

The second approach relies on a method developed and used by the Population Division of the United Nations. This method assumes that the percentage of the entire population that is urban follows an S-shaped curve. Therefore, the rate of urbanization will be slow at first, accelerate when the percent urban reaches 30-70 percent, and then slow down once urbanization reaches high levels. This approach requires an estimate of the annual growth rates of the urban and rural populations in the base year and the size of the urban population by age and sex in the base year. A complete description of the methodology used can be found in the DemProj manual, Chapter V.

2. Population of Major City

Description and Methodology: The population of the major city is calculated by assuming that the largest city will remain some chosen percentage of the total urban population. This percentage may be modified for each year of the projection to reflect either increased or decreased migration into that particular city. This indicator is useful in illustrating the future urban infrastructure requirements. Also, overall populations in urban areas (especially in the largest cities) tend to grow more rapidly than in the rural areas population, so that related population effects also appear more rapidly. Many audiences will be able to recall clearly and easily when there were many fewer persons living in the largest city, and how the quality of life in the city (e.g., crime rates, unemployment, transportation, water supplies, education, etc.) was much better before the population grew too large.

Equation:

$$MajorCityPop_t = UrbanPop_t \bullet \%UrbanPopMajorCity_t \ ,$$

where:

$MajorCityPop_t$	=	population living in the major city in time t
$UrbanPop_t$	=	total urban population in time t
$\%UrbanPopMajorCity_t$	=	percentage of the total urban population living in the major city in time t.

Inputs and Sources:

Total urban population projection

The DemProj module supplies this variable.

Percentage of the total urban population living in the major city

This figure can be taken directly from the sources listed, or can be estimated by dividing the population living in the major city in a year by the total urban population in that year. This assumption may remain constant in the future, or may be changed to reflect migration policies. It may also be changed based on past growth of the major city.

3. Urban Youth (Aged 12-25)

Description and Methodology: The number of urban youth is calculated by summing the number of persons in urban areas between the ages of 12 and 25, inclusive. This indicator is useful in illustrating the number of new employment opportunities, educational opportunities, and housing facilities that will be required in urban areas in the future. It is also an indicator of political and societal stability, as this population has proven to be a destabilizing force when these necessities are absent.

Equation:

$$UrbanYouth_t = UrbanPop_{12\text{-}25,t}\ ,$$

where:

$$UrbanYouth_t \quad = \quad \text{the number of urban youth in time } t$$

$$UrbanPop_{12\text{-}25,t} \quad = \quad \text{urban population between the ages of 12 and 25 in time } t.$$

Inputs and Sources:

Population projection for the urban population aged 12-25

The DemProj module supplies this variable.

E. Agriculture

Introduction

Agriculture is the key economic sector in many developing countries since it provides a significant proportion of the economy's employment, food, and export earnings. In countries with abundant land and few urban centers, rapid population simply leads to more land under cultivation. However, when land is scarce and a significant proportion of the population lives in cities, then rapid population growth raises the dual

problem of less land per capita for food production and more people to feed. Improvements in technology and management can raise yields and lead to increases in the amount of food produced even if the amount of arable land is shrinking. However, it takes time to develop and implement new technologies. Rapid population growth may make it difficult to adopt new technology that will keep up with rising demand for food. In addition, as the intensity of cultivation increases, environmental problems may arise from the clearing of new lands for cultivation, from heavy fertilizer use, and from intensive irrigation. The RAPID model addresses these issues by projecting the amount of arable land per capita in the future and the demand and supply of certain key crops. These indicators are intended to illustrate the pressures created by rapid population growth in the agriculture sector.

Methodology

1. Arable Land per Capita

Description and Methodology: The amount of arable land available per capita is projected by dividing the total arable land area by the total population. This indicator is useful in demonstrating how the amount of land supporting each person (or family) will be reduced in the future (i.e., as the population grows and the amount of arable land remains relatively constant, the parcels of land available to support each person or family will become smaller).

Equation:

$$ArableLandPerCapita_t = ArableLand_t / TotalPop_t \; ,$$

where:

$ArableLandPerCapita_t$ = amount of arable land available per capita in time t

$ArableLand_t$ = total amount of arable land in time t

$TotalPop_t$ = total population in time t.

Inputs and Sources:

Total arable land

The future amount of total arable land usually remains constant. It can, however, be changed to reflect a country's development plans or to reflect changes brought about by nature (e.g., increases in arable land through irrigation schemes, or reductions in arable land due to desertification). Setting future assumptions to reflect national goals is useful in demonstrating the difficulty in maintaining current arable land per capita ratios with continued high rates of population growth.

Total population projection

The DemProj module supplies this variable.

2. Consumption of Major Crop

Description and Methodology: The total annual consumption of a country's major crop is projected by multiplying the average annual per capita consumption of that crop by the total population for each year of the projection. This indicator is useful in demonstrating how food production and/or food imports will have to increase in direct proportion to increases in the population. Basic staple crops, such as rice or maize, are usually considered in this analysis.

Equation:

$$MajorCropCons_t = ConsPerCapita_t \bullet TotalPop_t ,$$

where:

$MajorCropCons_t$	=	total annual consumption of major crop in time t
$ConsPerCapita_t$	=	per capita consumption of major crop in time t
$TotalPop_t$	=	total population in time t.

Inputs and Sources:

Per capita consumption of major crop

This figure can be taken directly from the sources listed, or can be estimated by dividing the total consumption (or production +/- imports) of the crop in a year by the total population in that year. The future per capita consumption of the crop can remain constant, or can be changed to reflect increases or decreases in individual income.

Total population projection

The DemProj module supplies this variable.

3. Production of Major Crop

Description and Methodology: The total annual production of the country's major crop is projected by multiplying the total production in the previous year by an exogenously specified growth rate. This indicator is especially useful when combined with the annual consumption of the crop to demonstrate the difficulty of food production maintaining pace with population growth. (Note: The production of the major crop in the base year is entered directly into the model.)

Equation:

$$MajorCropProd_t = MajorCropProd_{t-1} \bullet (1 + ProdGrowth_t) \,,$$

where:

$MajorCropProd_t$	=	total annual production of major crop in time t, for $t > 1$
$ProdGrowth_t$	=	annual increase in crop production in time t.

First-year major crop production ($t = 1$) is simply the production itself without the multiplier for growth.

Inputs and Sources:

Production of major crop in the base year

This figure must be taken directly from the sources listed.

Annual increase in crop production

Potential Sources: National development plans, statistical yearbooks, FAO Production Yearbook

This figure can be taken directly from the sources listed, or can be computed from a time series. The assumption regarding the future annual crop production increase can remain constant in the future, or can be changed to reflect a country's agricultural goals. Setting the future assumptions to reflect target goals can be useful in demonstrating that achieving the goals will have little impact on improving the situation in the country, as increases will be used to merely offset the growth in population.

IV. Program Tutorial: RAPID/Spectrum

This tutorial covers the key steps in installing and running Spectrum and RAPID.[2] It assumes that you have an IBM-compatible computer running Windows 3.1 or Windows 95 and that you are familiar with the basic operation of Windows programs and terminology.

A. Before You Get Started

First, you will need to run DemProj, part of the Spectrum system of policy models; please refer to its manual for more information. Then you will need to collect data and make certain decisions before running the model. For example, you will need to decide the following at the very beginning:

- whether to include all the sectors available in this model: economy, education, health, urbanization, and agriculture

- whether to include all the variables for each sector, as described below.

You will need to collect data before running the model. For example, the data you may need include:

For the economy:

- labor force participation rate for males aged 10-14 and 15-64

- labor force participation rate for females aged 10-14 and 15-64

- base year gross domestic product

- annual growth rate in GDP percentage

For education:

- age of entry into primary school and secondary school

- number of years of primary and secondary schooling

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[2] There are two versions of RAPID: Spectrum and Excel. The Excel spreadsheet permits the user to customize equations and variables as appropriate for the country and region. A brief tutorial for RAPID/Excel follows in Chapter V.

- primary and secondary school enrollment rate
- students per primary and secondary teacher
- students per primary and secondary school
- recurrent expenditure per primary and secondary school student

For health:
- population per doctor, nurse, health center, hospital, and hospital bed
- annual health expenditure per person

For urbanization:
- percent of urban population in major city
- persons per urban household

For agriculture:
- arable land (in million hectares)
- base year production of major crop (thousand metric tons)
- annual growth in production of major crop (%)
- annual per capita consumption of major crop (kilograms)

B. Installing the Spectrum Program

The Spectrum program is distributed on floppy diskettes; it is also available through the Internet at http://www.tfgi.com/ software/software.htm. However, it must be installed on a hard disk before it can be used.[3] Spectrum will run on any computer running Windows 3.1 or Windows 95. It requires about 3MB of hard disk space.

To install the Spectrum program, start by inserting the "Install" diskette into your floppy disk drive.

For Windows 3.1: Select "File" from the Program Manager menu, then select "Run." In the dialogue box that appears, type the file name "a:\setup.exe" and press "Ok." (If the install disk is in floppy disk drive b, then use the file name "b:\setup.exe".)

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[3] To remove the Spectrum program from your hard disk, run the Unwise program located in the Spectrum directory.

Follow the instructions on the screen to complete the installation.

For Windows 95: Select "Start" from the task bar. Then select "Run" from the pop-up menu. In the dialogue box that appears, type the file name "a:\setup.exe" and press "Ok." (If the install disk is in floppy disk drive b, then use the file name "b:\setup.exe".) Follow the instructions on the screen to complete the installation.

C. Creating a New Projection

1. Starting the Spectrum Program

To start Spectrum, use one of the following methods:[4]

In Windows 3.1:

1. Double-click on the Spectrum icon on the desktop, or

2. Use the File Manager to locate the directory "c:\spectrum\" and then double-click on the file named "spectrum.exe".

In Windows 95:

1. Click the "Start" button on the task bar.

2. Select "Programs" from the pop-up menu.

3. Select "Spectrum" from the program menu. Alternatively, you can use Windows Explorer to locate the directory "c:\spectrum" and double-click on the file named "spectrum.exe".

2. Opening a Demographic Projection

Before using RAPID, you should use DemProj to prepare a demographic projection. DemProj is part of the Spectrum System of Policy Models; for more information, consult its manuals.

The RAPID model in Spectrum requires a demographic projection prepared with DemProj. In a typical RAPID application, the demographic projection provides the demographic information (i.e., population projection information by age and sex) used to make the socioeconomic projections in RAPID. Therefore, before using RAPID, you should prepare a demographic projection using DemProj. For more information on DemProj, consult the DemProj Manual for Spectrum that is a companion to this one, *DemProj: A Computer Program for Making Population Projections.*

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[4] The computer screen prototypes in this manual correspond to Windows 95.

The first step in preparing the RAPID projection is to open the demographic projection.

1. Select "File" from the menu bar.

2. From the pull-down menu that appears, select "Open projection."

3. Select the projection file from the "Open" dialogue box and press "Ok." All pre-existing projections that can be loaded will be listed here.

3. Adding the RAPID Module to the Projection

Once the demographic projection is open, you will need to change the configuration to indicate that the RAPID module will be used as well. To do this, select "Edit" from the menu bar and "Projection" from the pull-down menu.

You will see the "Projection manager" dialogue box. It will look something like the display shown below.

Once all the information is entered for this dialogue box, click on the "Ok" button. You can always return to this screen and change some of the information by selecting "Edit" from the menu bar and "Projection" from the pull-down menu.
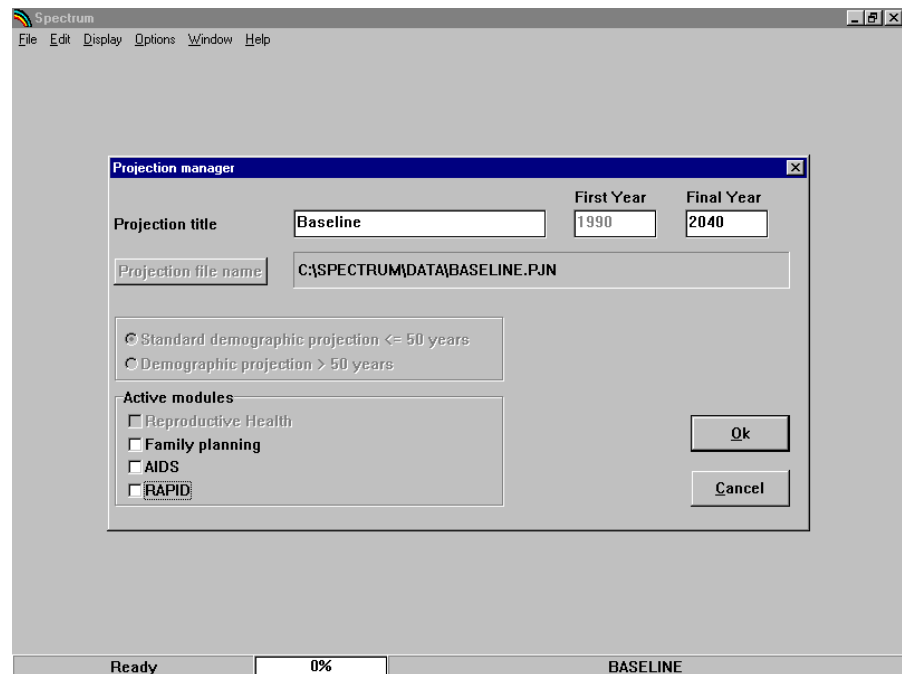
The following information is displayed.

Projection title: This title will be printed at the top of all printed output and will be used to identify the projection if more than one projection is loaded at a time. You can change the title to reflect the projection you are about to prepare.

Projection file name: This is the name that will be used to store all data files associated with this projection. You cannot change the file name here. You can change it if you select "File" and "Save projection as" to save the projection to a new name.

First year: This is the first year of the projection, determined in the DemProj projection.

Final year: This is the final year of the projection, determined in the DemProj projection.

Demography. The radio button labeled "Standard demographic projection <= 50 years" will be selected by default. You cannot change this choice here because the demography module is required to make the RAPID projection.

Active modules. These radio buttons (or options) let you select other Spectrum modules that will be used with the population projection. Initially none of them will be selected. You should select the "RAPID" module by clicking on the check box next to the name. This step will allow you to include the RAPID module in the projection.

D. Entering the Socioeconomic Projection Assumptions

1. Selecting the Socioeconomic Projection Sector

For readers who feel they need additional review or explanations of the terms found in this section, Chapter III and the glossary of this manual may be useful.

The assumptions for the socioeconomic projections are entered by selecting "Edit" from the menu bar and "RAPID" from the pull-down menu. A dialogue box like the one shown below will appear.
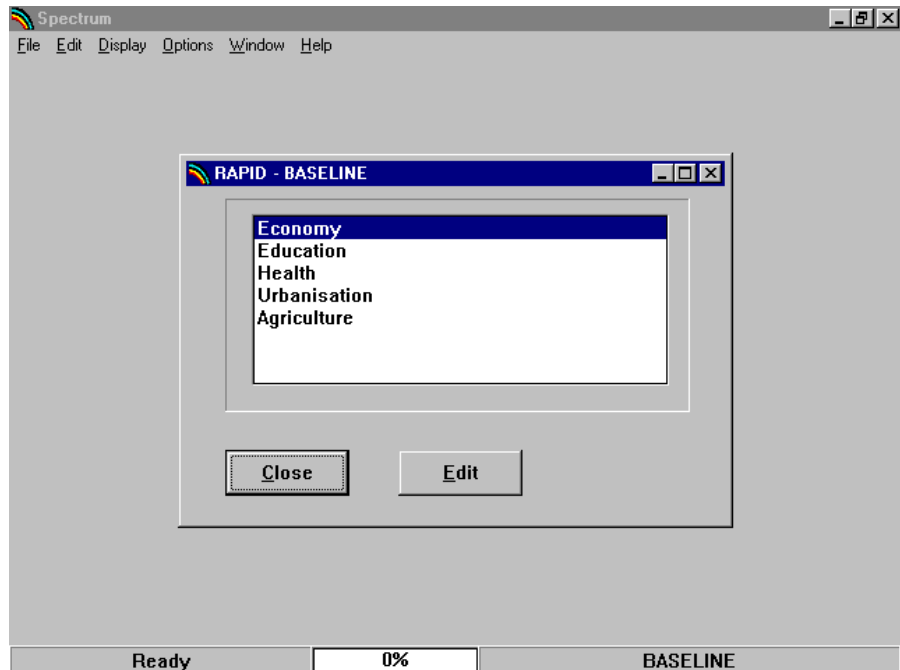
The sector, which contains the data to be entered or modified, must then be selected from this menu. To select the sector, either double-click the sector name, or highlight the sector name and click on the "Edit" button.

2. Entering or Editing the Assumption Data

Once the sector has been selected, the data for the assumptions underlying the equations in that sector will be displayed. The data for the economy sector, for example, will appear in a screen similar to that shown below.
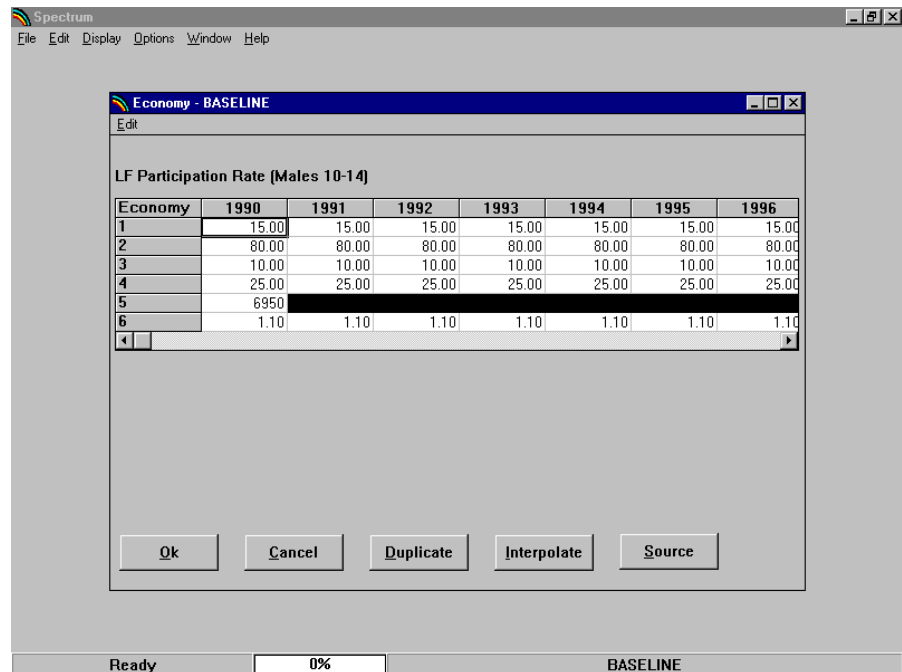
About the Editors

Each editor in is similar.   At the very top of the screen are the sector and projection name (e.g., Economy - BASELINE), where Economy is the sector and Baseline is the name of the projection. Below that is the name of the indicator being edited. In the preceding screen, the indicator is LF (labor force) Participation Rate (Males 10-14). The indicator name will vary according to the row being edited. In the case above, note that the indicator highlight (rectangular box) is in the cell corresponding to 1990 (vertical) and 1 (horizontal). As the row changes from 1 to 2 to 3, etc., the name of the indicator also changes; see the next screen, where row 4 corresponds to the LF (labor force) Participation Rate (Females 15-64).
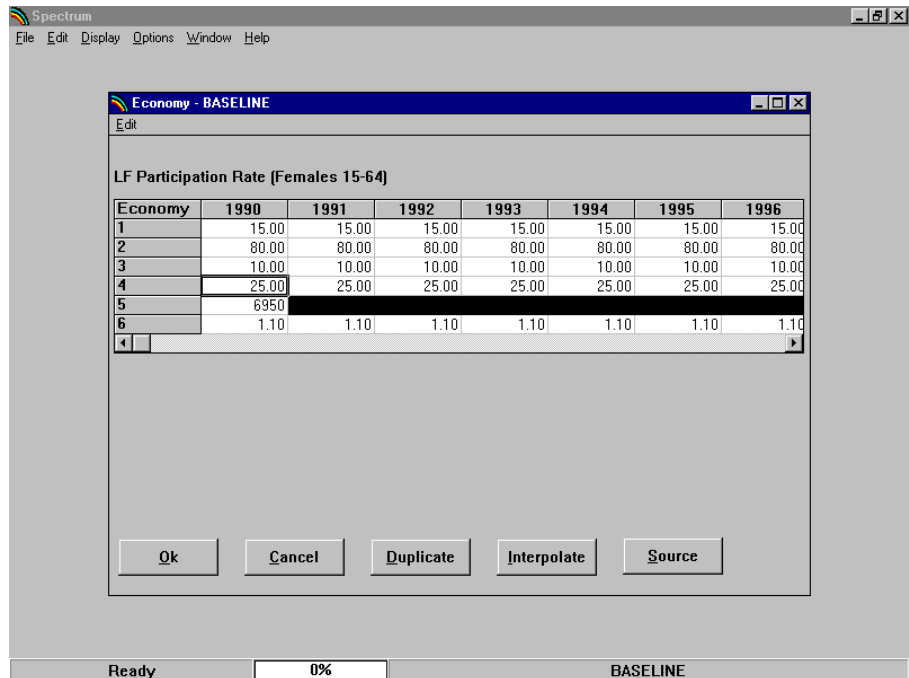
You can move through the editor entering the data into the appropriate cell locations.

At the bottom of the screen are the special edit keys. "Duplicate" allows you to copy information from one cell, column or row to another; "Interpolate" to enter a beginning and ending number and have the computer calculate numbers for the intervening intervals; and "Source" to write notes indicating the source of the data for future reference.

To use the "Duplicate" button,

1. Highlight (select) the range (column, row, or cells to be affected). The first cell in the range should be the value you want to copy.

2. Extend the range to the last year by using the mouse (hold down the left button and drag the range) or the keyboard (hold down the shift key and use the arrow keys).

3. Click on the "Duplicate" key to copy the value at the beginning of the range to all the other cells in the range.

To use the "Interpolate" button,

1. Enter the beginning and ending values in the appropriate cells.

2. Highlight the entire range from beginning to end.

3. Click on the "Interpolate" key to have the values interpolated and entered into each of the empty cells.

To use the "Source" button,

1. Click on the "Source" button to open a small word processor window.

2. Enter the source of the data and make any special comments about the assumptions.

3. Click on "Close" to return to the editor.

This feature allows you to keep a record of the data sources and assumptions as you make the projections. This source information will be maintained with the data file and printed whenever you print the projection summary. It is **strongly** recommended that you use this feature to avoid later confusion.

When you have finished entering all the necessary data for the component into the editor, click the "Ok" button to return to the "Sector selection" dialogue box. Click the "Close" button to complete the editing process, or click on another sector to edit the data for that sector.

The "Cancel" button allows you to exit the editor without making any changes to the data for the sector.

For the economy

There are six types of information that can be entered for this sector; the numbers here correspond to the rows on the screen where the data should be entered.

1. The LF (labor force) Participation Rate (males 10-14)

2. The LF (labor force) Participation Rate (males 15-64)

3. The LF (labor force) Participation Rate (females 10-14)

4. The LF (labor force) Participation Rate (females 15-64)

5. The base year gross domestic product (GDP Millions)

6. Annual growth rate in GDP%

When you have finished entering all the necessary data for the economic component into the editor,

1. Click the "Ok" button to return to the "Sector selection" dialogue box.

2. Click the "Close" button to complete the editing process or double-click "Education" to enter that editor.

For education

There are 12 types of information that can be entered for this sector; the numbers here correspond to the rows on the screen where the data should be entered.

1. Age of entry into primary school

2. Number of years of primary schooling

3. Primary school enrollment rate (percentage)

4. Students per primary teacher

5. Students per primary school

6. Recurrent expenditure per primary school student

7. Age of entry into secondary school

8. Number of years of secondary schooling

9. Secondary school enrollment rate (%)

10. Students per secondary school teacher

11. Students per secondary school

12. Recurrent expenditure per secondary school student

When you have finished entering all the necessary data for the education component into the editor,

1. Click the "Ok" button to return to the "Sector selection" dialogue box.

2. Click the "Close" button to complete the editing process or double-click "Health" to enter that editor.

For health

There are six types of information that can be entered for this sector; the numbers here correspond to the rows on the screen where the data should be entered.

1. Population per doctor

2. Population per nurse

3. Population per health center

4. Population per hospital

5. Population per hospital bed

6. Annual health expenditure per person

When you have finished entering all the necessary data for the education component into the editor,

1. Click the "Ok" button to return to the "Sector selection" dialogue box.

2. Click the "Close" button to complete the editing process or double-click "Urbanization" to enter that editor.

For urbanization

There are two types of information that can be entered for this sector; the numbers here correspond to the rows on the screen where the data should be entered.

1. Percent of urban population in major city (%)

2. Persons per urban household

When you have finished entering all the necessary data for the urbanization component into the editor,

1. Click the "Ok" button to return to the "Sector selection" dialogue box.

2. Click the "Close" button to complete the editing process or double-click "Agriculture" to enter that editor.

For agriculture

There are four types of information that can be entered for this sector; the numbers here correspond to the rows on the screen where the data should be entered.

1. Arable land (Million hectares)

2. Base year production of major crop (Thousand MT) (metric tons)

3. Annual growth in production of major crop (%)

4. Annual per capita consumption of major crop (KG) (kilograms)

When you have finished entering all the necessary data for the agriculture component into the editor,

1. Click the "Ok" button to return to the "Sector selection" dialogue box.

2. Select the "Close" button to keep your work, and you will return to the main program.

3. Saving the Input Data

Once you have entered the projection assumptions, it is a good idea to save the data onto your hard disk. To do this, select "File" from the menu bar and "Save projection" from the pull-down menu. The data will be saved using the file name you specified earlier.

E. Making the Socioeconomic Projection

Whenever you enter data for a new projection or edit the assumptions, RAPID will note that the data have been changed. The next time you try to display an indicator, it will inform you that the data may have changed and ask if you want to recalculate the projection. Normally, you should answer "Yes" to this question. RAPID will then make the population projection. This message will occur if you edit any of the RAPID or DemProj information, since a change to the DemProj inputs will affect the population projection and, thus, also affect the RAPID socioeconomic projections. To make the projections may take only a few seconds if you are making only a population and RAPID projection, or could take somewhat longer if you are also making a projection including AIDS or family planning modules. Once the projection is made you will not be asked if you want to project the population again unless you edit the assumptions.

F. Examining the Output

To see the results of the projection, select "Display" from the menu bar. From the pull-down menu select "RAPID."

You will then see another menu showing the sectors available:

- Economy
- Education
- Health
- Urbanization
- Agriculture

Choose one of these sectors. Once you have selected a sector, the indicators available for that sector will appear. For the economy sector, for example, the screen will appear as shown below.
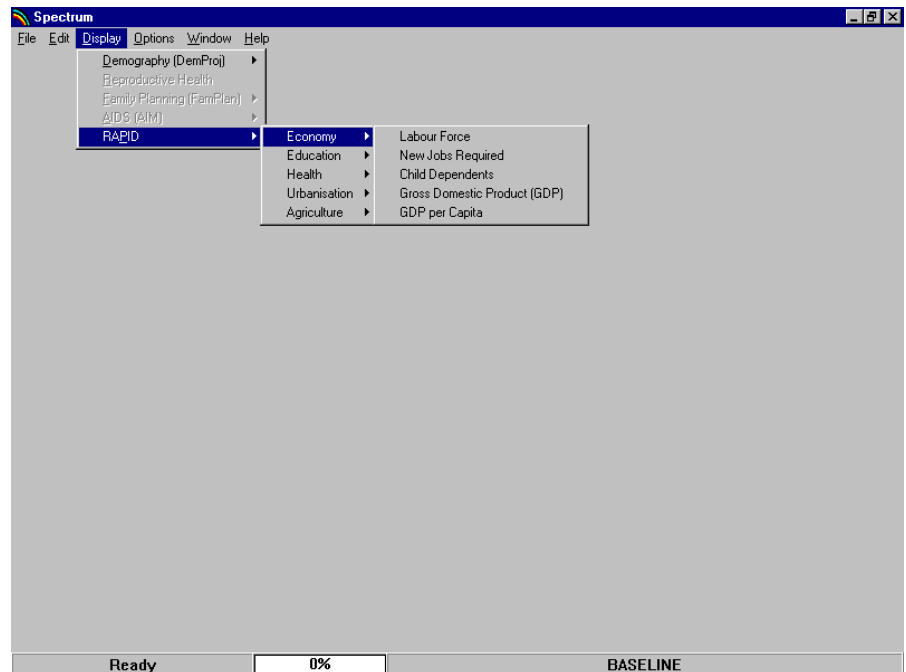
You must then select the indicator to be displayed.   Then you will see the display dialogue box. It will look something like the one shown below.
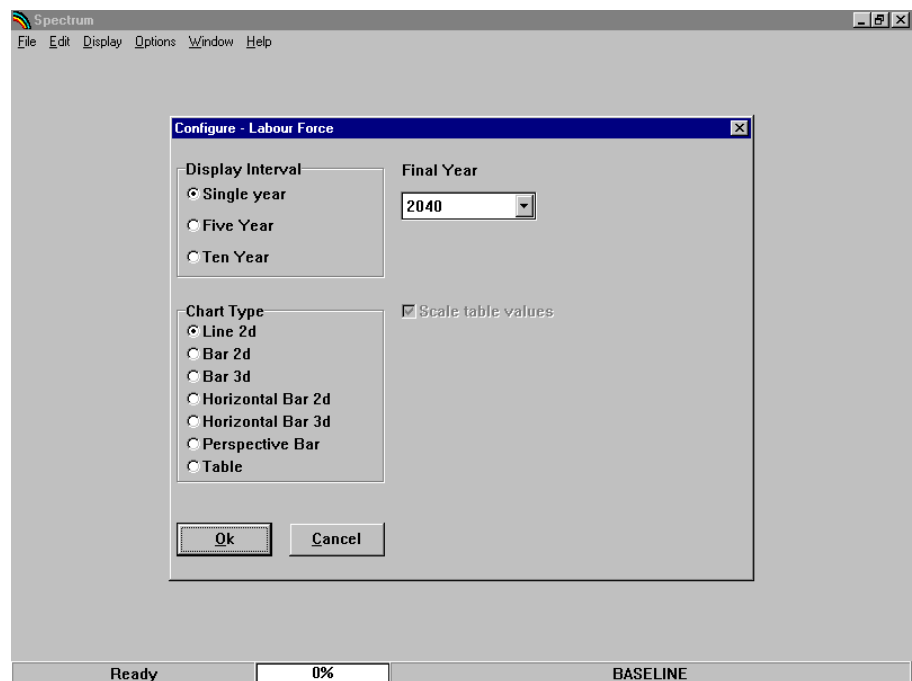
The display will normally be in single years but you can change it to display every five or ten years if desired.   The chart type is

also set through this dialogue box; click on the button next to the type of display you want.   Normally the display will show all the years in the projection.   However, if you want to see only part of the projection, you can change the final year by selecting a new final display year from the "Final year" list box.

Once you are satisfied with the type of display, click the "Ok" button and the display will appear.   (You may also press the "Cancel" button to cancel the display.) It will look something like the display shown below.
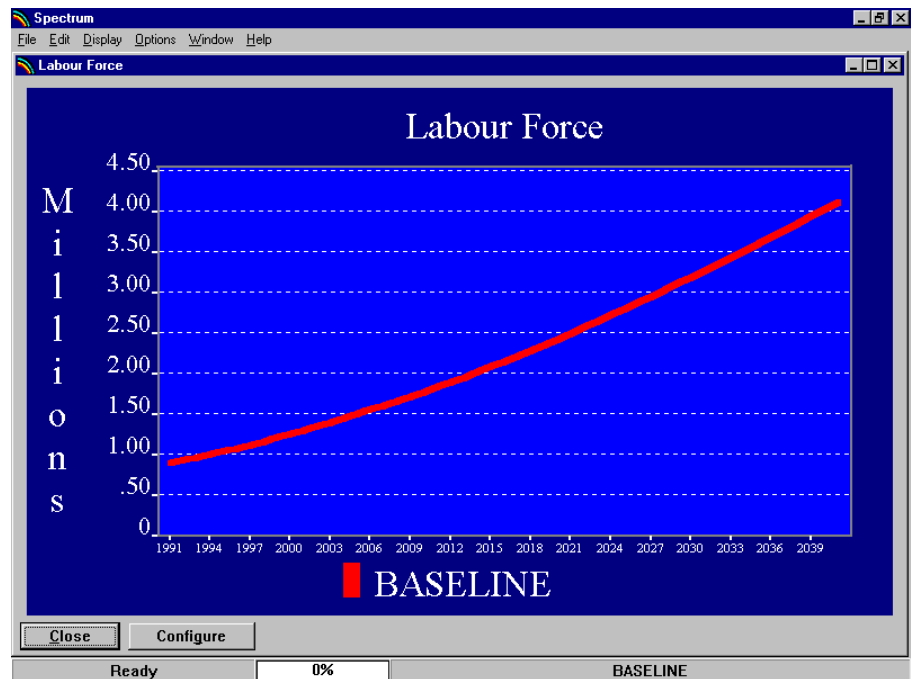
All the projections that are currently in use will be displayed on the same graph.

You can change the configuration of the display by clicking the "Configure" button. You can also change the type of display by putting the mouse pointer anywhere inside the chart and clicking with the right mouse button.

To close the display, click on the "Close" button. You do not have to close the display immediately. You can choose to display another indicator, and it will appear on top of the first display. The first display will be covered but it will still be there. You can return to any previous display that you have not closed by choosing "Window" from the menu bar and selecting the name of the display from the pull-down menu. From the "Window" selection, you can also choose to tile or cascade all the existing display windows.

1. Graphs and Bar Charts

Spectrum will display a variety of graphs and bar charts including:

- Line charts
- Two- and three-dimensional bar charts (column charts)
- Two- and three-dimensional horizontal bar charts
- Two- and three-dimensional overlap bar charts (bars for multiple projections are shown on top of each other)
- Three-dimensional perspective bar charts

To print the active (selected) chart, select "File" from the menu bar and "Print" from the pull-down menu.

2. Tables

Spectrum will also display data in the form of tables. In tables, each projection that is in use will be displayed in a separate column. You can scroll through the table to see all the years by using either the PgUp and PgDn keys or the mouse.

To print a table, select "File" from the menu bar and "Print" from the pull-down menu.

G. Saving the Projection

It is always a good idea to save the projection whenever you make a change to any assumptions. To save the projection without changing the name, choose "File" from the menu bar and "Save projection" from the pull-down menu.

To save the projection with a different name, chose "File" from the menu bar and "Save projection as" from the pull-down menu. You will then have a chance to specify a new file name for the projection. Normally, when you save the projection with a new name, you should also change the projection title. This step will avoid confusion if you have both projections loaded at the same time.

H. Opening an Existing Projection

If you have already created a DemProj projection or are using a projection provided by someone else, you can immediately load that projection by selecting "File" from the menu bar and "Open projection" from the pull-down menu. Select the file

you wish to use and click the "Ok" button to open the projection.

You can open more than one projection at a time. Just repeat these steps to load a second or third projection. When you have more than one projection loaded, all projections will be displayed in the graphs and tables. The number of projections you can load at any one time is determined by the amount of available memory in your computer.

When you have more than one projection loaded, you will be asked to choose a projection when performing certain tasks, such as editing assumptions. The program will display a list of the projection names, and you can choose the appropriate one from the list.

I. Closing a Projection

To remove a projection that has already been opened, choose "File" from the menu bar and "Close projection" from the pull-down menu. If you have more than one projection loaded, you will be asked to select which projection should be closed. Closing a projection just removes it from the computer's memory; it does not erase it from the hard disk. You can open that projection again at any time.

V. Program Tutorial: RAPID/Excel

A special spreadsheet version of the RAPID module has also been created for use with Microsoft Excel.[5] This version is intended to allow counterparts to design and develop their own socioeconomic equations, using the demographic projections created through the Spectrum system.   While this version offers a great deal of flexibility in developing equations, it assumes that the user is familiar with Microsoft Excel (to develop the equations) and PowerPoint (to develop the graphs to accompany the equations).

As mentioned earlier, demographic files created through the Spectrum system can be transferred to the special spreadsheet versions of the RAPID and AIM programs. (See the DemProj manual for more details on this transfer process.) To save a DemProj file in a form suitable for use with the spreadsheet versions of RAPID or AIM, select "File" from the menu bar then select "Export" from the pull-down menu. From the next menu, select "Demography." Finally you can select the type of file you wish to create: a RAPID file or an AIM file. After you specify the file name, the projection will then be saved in a special format that can be read into the spreadsheet versions of RAPID or AIM.

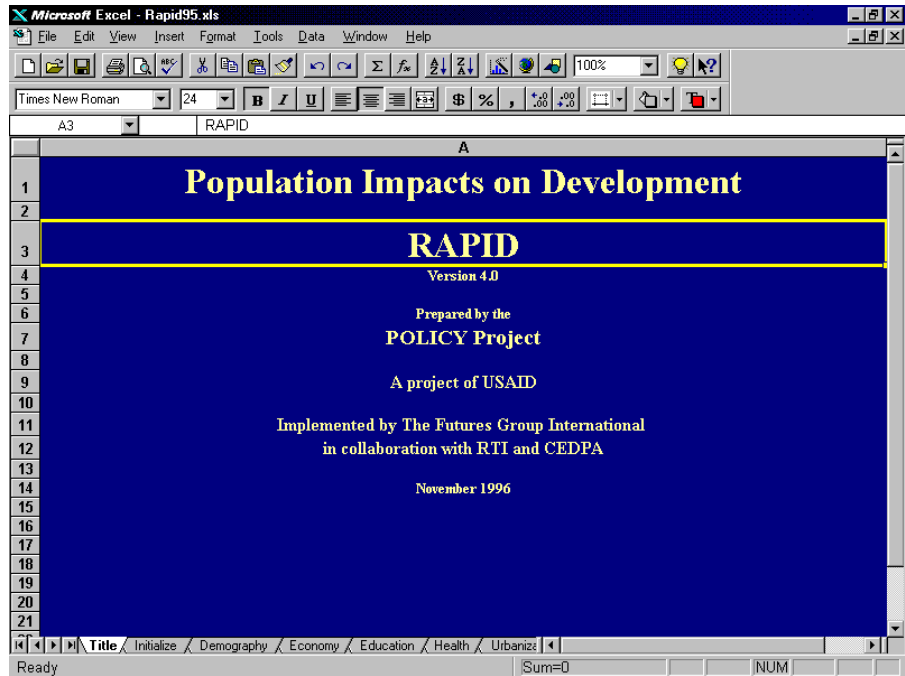## A. Loading the RAPID Excel Spreadsheet

1. Starting the Excel Version

To start the Excel version of the program, first start the Microsoft Excel program.

2. Loading the RAPID Excel Spreadsheet

Next, you will need to load the RAPID Excel spreadsheet.   To do this, first select "File" and "Open" from Excel.   Then select the file titled "RAPID.XLS" from your disk; it can be found in c:\spectrum\excel.   The file will automatically load, and you will be placed in the introduction screen, shown below:

---

[5] There are two versions of RAPID: Spectrum and Excel. The Excel spreadsheet permits the user to customize equations and variables as appropriate for the country and region. A brief tutorial for RAPID/Spectrum can be found in Chapter IV.

The RAPID Excel version has been loaded at this point. At the bottom of the screen are tabs allowing you to navigate through the spreadsheet (e.g., Title, Initialize, Demography, etc.). You can move through the spreadsheet by clicking on the appropriate tab.

B. Initializing the Projection

Once the file has been loaded, it is necessary to enter certain basic information about the spreadsheet and load the appropriate demographic data files into the spreadsheet. This process is called "initialization" and must be done the first time data for a country are being analyzed. Once a file has been initialized and saved, it will only be necessary to initialize it again if the demographic data files change.

The initialization screen appears as follows.
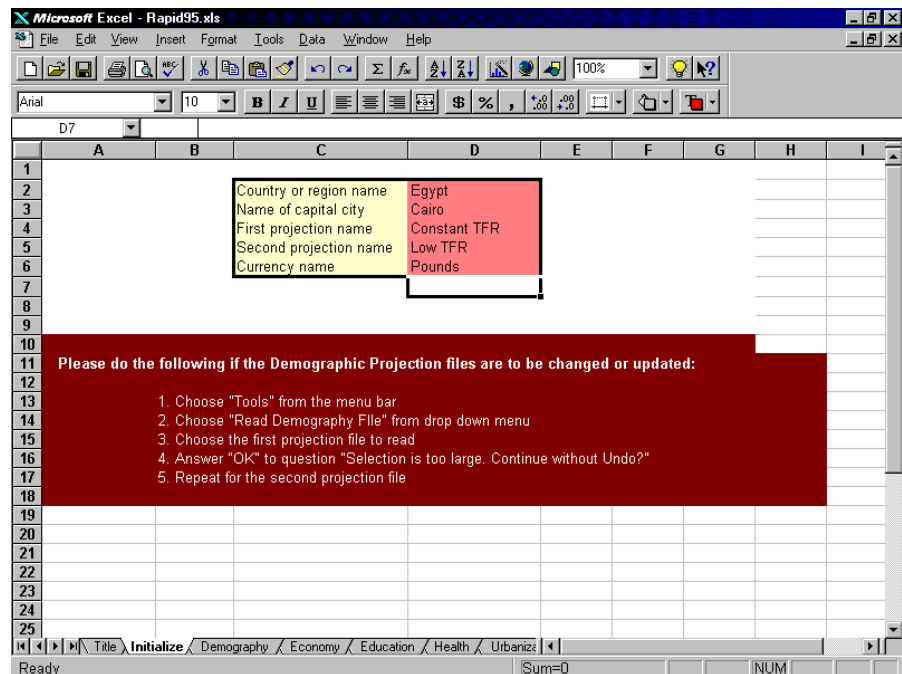
The data at the top of the initialization screen should be typed directly into the appropriate dark-shaded cells.   For example, if Kenya were being analyzed, you would type "Kenya" into the cell where "Egypt" appears and "Nairobi" where "Cairo" appears.

At the bottom of the screen are instructions for loading demographic projection files into the file. The RAPID Excel spreadsheet allows you to examine two population projections simultaneously, so these instructions must be followed for both projections being analyzed.

C. Examining and Editing Sector Indicators

In the RAPID Excel version, the underlying data, equations, and outputs are all contained on the same page.   The Economy sector page, for example, would appear as follows.

The inputs for the sector appear in yellow and are contained at the top of the screen. The projections and equations for the indicators appear in white and are contained at the bottom of the screen. In Economy, for example, the underlying assumptions are labor force participation rates for males and females, base year GDP and GDP annual growth. The values entered for 1995 are 65%, 14%, 20850, and 4.0% respectively. The calculated values for the first projection, size of male labor force, are 798 thousand in 1995 for both the constant TFR and low TFR projections. The equation for the projection can also be seen as Male LF[t] = Males_15-64[t] • Male_LFPR[t]. Scrolling further down the page would reveal additional indicators and equations used in the economic sector.

To change the values for the assumptions, move to the cell containing the input data to be changed and enter the new information. Likewise, to enter a new equation or modify an existing equation, move to the cells which calculate the indicator and enter the new equation. If you enter or change data or equations for the model, you should "Save" the file before exiting. This step will enable you to save the changes that were made.

The only display option currently available in the spreadsheet is to examine the data in tabular format. Graphs, however, can be drawn within the Excel program or the data can be extracted to a PowerPoint file for presentation purposes.

VI. References

Cincotta, R. and Engelman, R. 1997. *Economics and Rapid Change: The Influence of Population Growth*. Occasional Paper No 3. Washington, DC: Population Action International.

Hyman, D. 1992. *Economics.* 2nd Edition. Boston: Irwin.

National Research Council. 1986. *Population Growth and Economic Development: Policy Questions*. Washington, DC: National Academy Press.

Shane, B. 1997. *Family Planning Saves Lives* . 3rd Edition. Washington, DC: Population Reference Bureau.

Haupt, A., and T. Kane. 1989. *Population Handbook: International Edition.* 2nd Edition*.* Washington, DC: Population Reference Bureau.

Proceedings of the Conference on Population and the East Asian Miracle, 7-10 January 1997. 1997. Honolulu: East-West Center Program on Population.

VII. Glossary

Some of the following terms were obtained from the Population Reference Bureau's *Population Handbook* (Haupt and Kane, 1989); others were taken from *Economics* (Hyman, 1992).

Annual growth rate in gross domestic product (GDP). The percentage by which the market value of total output produced by a nation changes in a year.

Annual recurrent expenditure. The total amount spent in a year on non-capital items, such as salaries, expendable supplies, and facility maintenance.

Arable land per capita. The land that is fit for cultivation, divided by the total population of a nation.

Average recurrent expenditure. The amount spent per unit of time (usually per year) on recurrent (non-capital) items per beneficiary of the expenditure category. For example, recurrent primary school expenditure per year per primary school student or recurrent maternal and child health (MCH) expenditures per year per child under age 5.

Catchment areas. A geographically defined area from which a service-providing entity (such as a health clinic or hospital) draws the majority of its customers or clients.

Gross domestic product (GDP). The market value of final output produced within the borders of a nation. A measure of income from use of resources within the borders of a nation.

Gross domestic product per capita. The market value of final output produced within the borders of a nation, divided by the total population of that nation. A measure of income from use of resources within the borders of a nation, per each person living there.

Gross national product (GNP). The market value of an economy's final goods and services produced over a period of one year.

Interpolation. Given two numbers that serve as boundary points, it is possible to estimate the values that lie at intervals between the two points. For example, if the total fertility rate for a country or region was actually measured only in 1980 and in

1995, by assuming even increments from year to year, it is possible to interpolate a TFR for each intervening year. (Spectrum uses a linear form of interpolation so that the difference between each annual value is the same. Other nonlinear forms of interpolation also are possible, but are not used in Spectrum.)

Labor force. The total number of persons between the ages of 15 and 64 with jobs in the formal sector and workers who are actively seeking a job in the formal sector but currently do not have one.

Labor force participation rate. The proportion of the total labor force (defined as all able-bodied persons within a defined adult age range) that is economically active in the formal economic sector. Note that farmers in many countries are not considered to be "economically active" in the formal sector either because they are subsistence farmers or because they barter their product outside of the formal sector.

Population projection. Computations depicting the future course of a population's size, its structure, and its interaction with dynamics such as fertility, mortality, and migration. The projection is constructed based on assumptions about the future course of those population dynamics.

Pop-up menu. A menu from which users can select items or actions. Pop-up menus can appear anywhere on the screen.

Pull-down menu. A menu opened by clicking on key words at the top edge of the screen. Pull-down menus allow users to select operations.

Radio button. These buttons emulate raised buttons on early radios, which were punched to select radio stations. The graphically portrayed raised "radio buttons" on interfaces permit users to select among alternatives.

Total fertility rate (TFR). The average number of children that would be born alive to a woman (or a group of women) during her lifetime if she were to pass through all her childbearing years conforming to the age-specific fertility rates of a given year.

VIII. Acronyms and Abbreviations

FAO	United Nations Food and Agriculture Organization
GDP	gross domestic product
ILO	International Labour Organization
IMF	International Monetary Fund
RAPID	Resources for the Awareness of Population Impacts on Development
TFR	total fertility rate
UNESCO	United Nations Educational, Scientific, and Cultural Organization
USAID	United States Agency for International Development

Appendix A

Typical RAPID Presentation

Moving
Forward:
Egypt and Its
Population

# The Impact of Population Growth in Egypt

Edward Abel

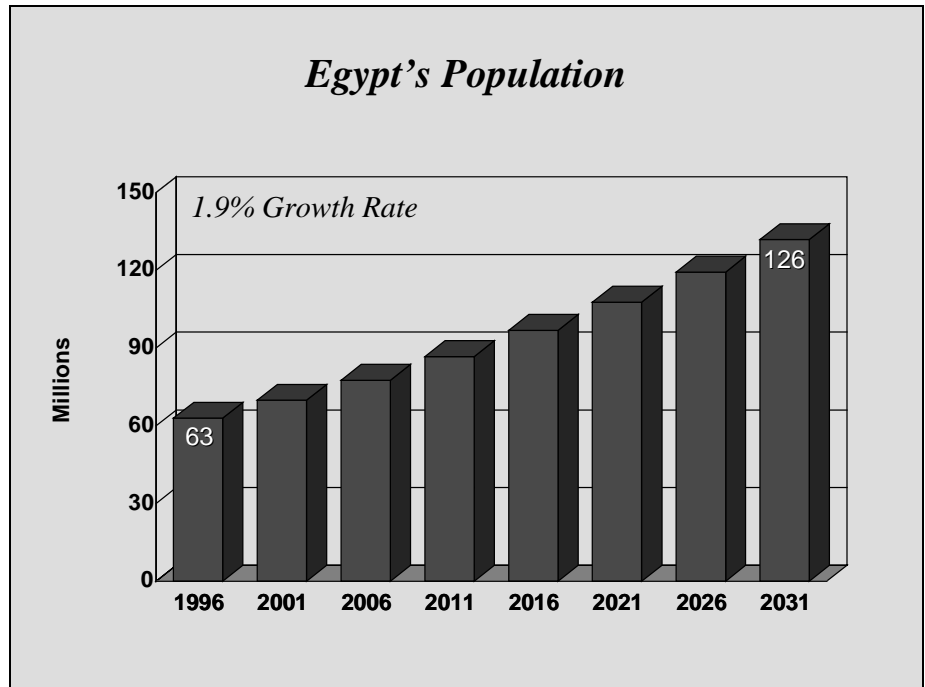**The POLICY Project**

June 1997

"I've repeated more than once that despite the reduction of population growth rates, still the greatest share of the development harvest is devoured... Therefore, our sole effective means to overcome this challenge is our faith that family planning will provide a better future to the family and to the whole community." —President Mubarak

Commitment to the family planning program on the part of everyone is required if this challenge is to be overcome.

**Contraceptive Prevalence Rate**
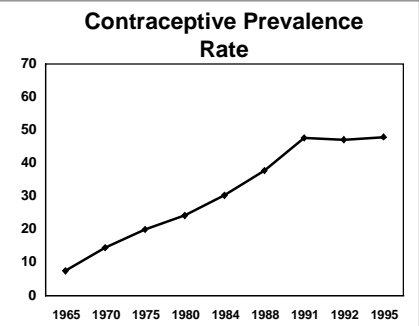
Renewed commitment to the family planning program on the part of everyone is required if this challenge is to be met. While contraceptive prevalence — a measure of family planning usage — increased steadily between 1965 and 1991, it has plateaued over the past few years, and questions are now being raised as to whether the program can continue its past success story.

Unless contraceptive prevalence breaks out of the current plateau, the population will grow dramatically in the future. In 1996, the census results showed a population of about 63 million that was growing at about 2.1% per year. If this level of growth were to continue, the population would double in size by 2031 — reaching nearly 126 million.

Egypt's Population

1.9% Growth Rate

Year	
1996	63
2031	126

(Bar chart titled "Egypt's Population" showing population in Millions on the vertical axis from 0 to 150, with years 1996, 2001, 2006, 2011, 2016, 2021, 2026, 2031 on the horizontal axis. The 1996 bar is labeled 63 and the 2031 bar is labeled 126.)

Population density is one of the most critical problems associated with the country's swelling population. While the population size causes significant problems in other countries such as China, India, and Bangladesh, the problems occurring here are far worse because of the small habitable land area. Currently, only 5.5% of the land is lived upon, and only 2.4% of the land area is arable.


5.5% habitable *and* 2.4% arable
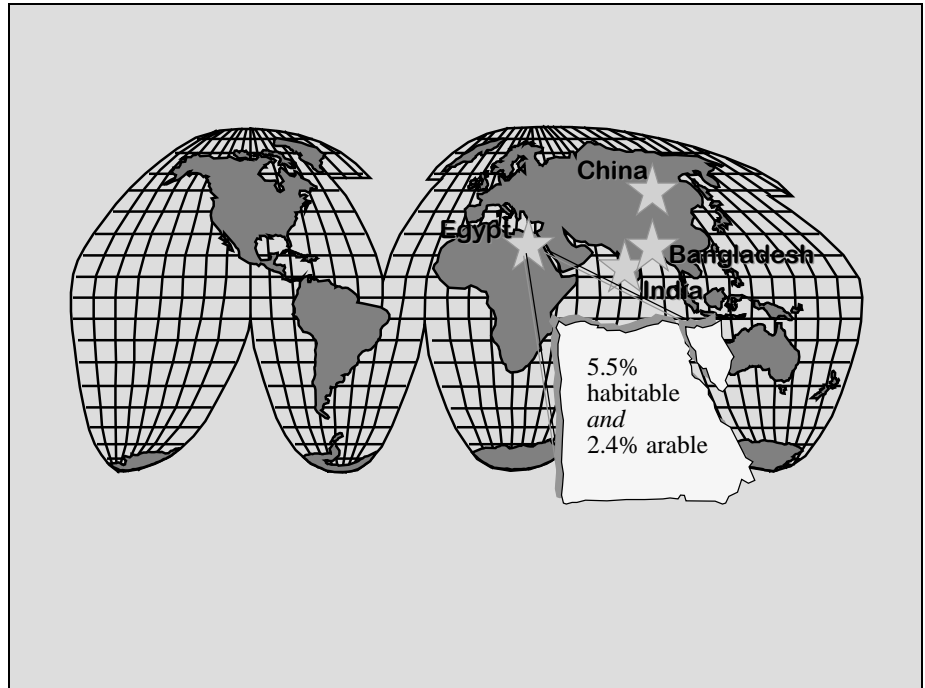
Bangladesh is often considered to be one of the most densely populated countries on earth. In Bangladesh, it is projected that each square kilometer of arable land must support about 1,400 persons in the year 2030. In Egypt, by comparison, each square kilometer of arable land supports nearly 2,600 persons. If the population were to continue growing at its current rate, this same square kilometer of land would need to support over 5,200 persons by 2030.

Comparative Density

👤 = 100 persons

| Bangladesh *1,400 people/km²*	Egypt *5,200 people/km²*
2030	2030
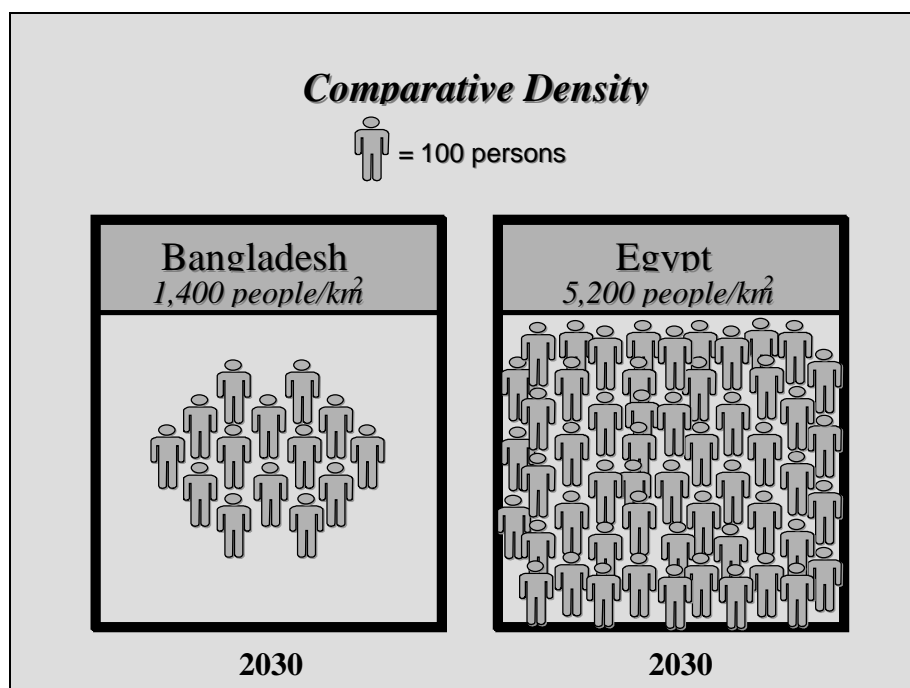
Advances in technology and population redistribution policies can help support a larger population in the future. It will, however, take time to develop and implement these advances, and population growth will reduce gains made by them.

The New Valley Development Project is an example of a forward-thinking policy designed to relieve some of the current population pressure. Through this project, about 2.2 million new arable feddans could potentially be added to the existing land supply — capable of supporting an additional 23.5 million people at today's land density levels. This project will help alleviate some of the current pressure, but it may not be sufficient by itself, as population growth will eat into this new land within a relatively short time. If, for example, the population were to continue growing at its current rate, land density — even with the New Valley Development Project — would revert to today's levels within 15 years.

New Valley Development

Current Arable Land

New Valley Arable Land

in 15 yrs.
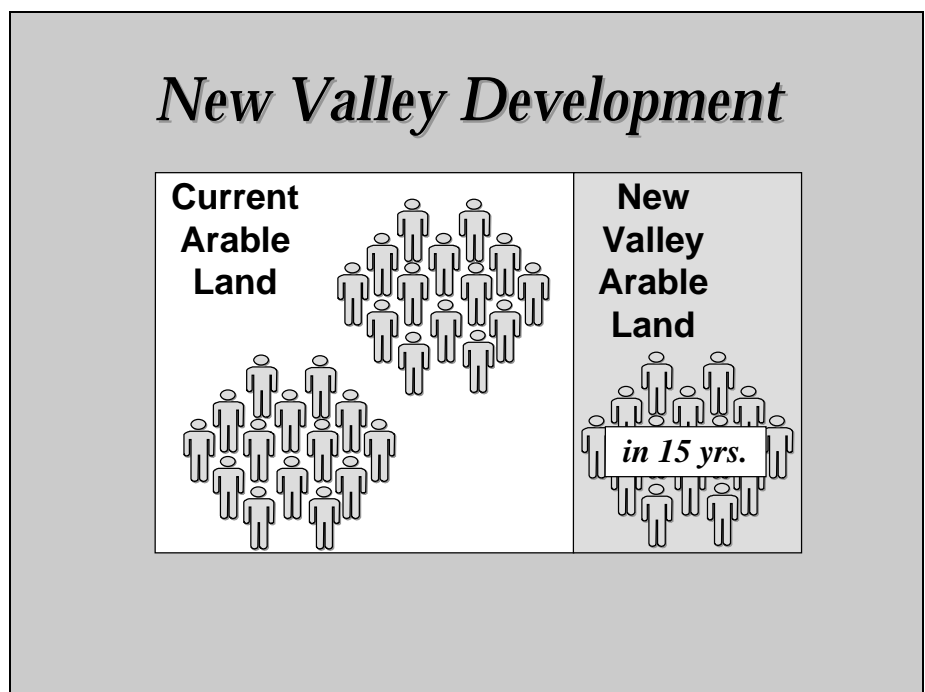
In today's presentation, we will examine some of the current critical population issues, and how they relate to national population goals: to reduce population growth; to enhance the quality of the population; and to improve the distribution of the population. To accomplish this, we'll first examine population growth trends. Next, we'll examine the consequences of future population growth. Finally, we'll examine actions that are effective in reducing the high rate of population growth.

Let's turn to our first point — trends in population growth over time. In 1897, 100 years ago, the population was about 10 million. Between 1897 and 1947, the population grew slowly — increasing to 19 million. Since 1947, however, the population has grown rapidly, rising to about 63 million in 1996.

Historical Population Growth
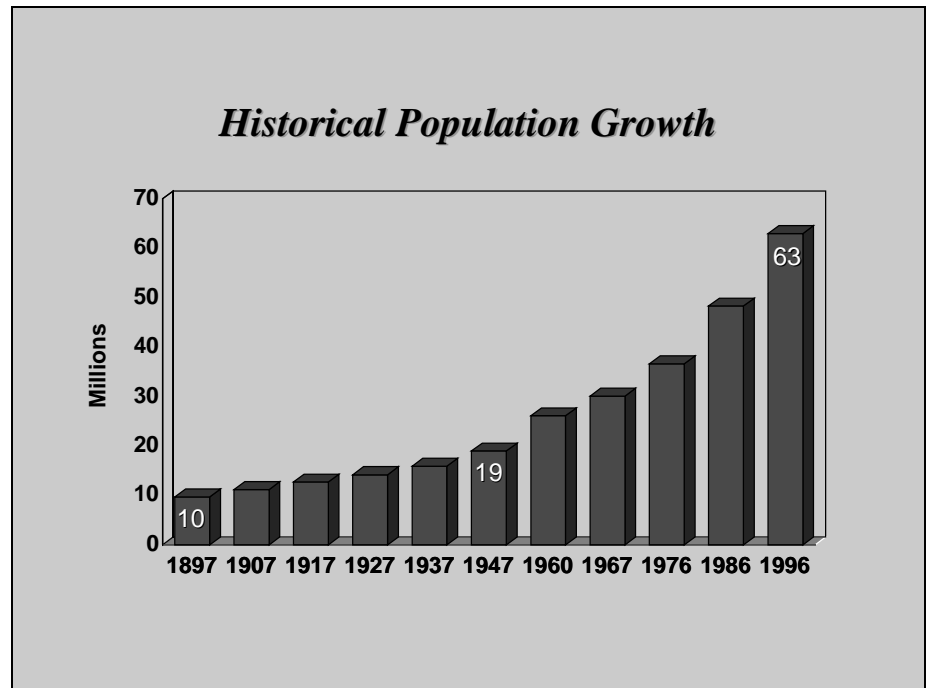
What has caused the population to grow so rapidly, especially in the recent past? In essence, recent population growth has been caused by the increasing difference between the annual number of births and deaths, or the natural growth rate.
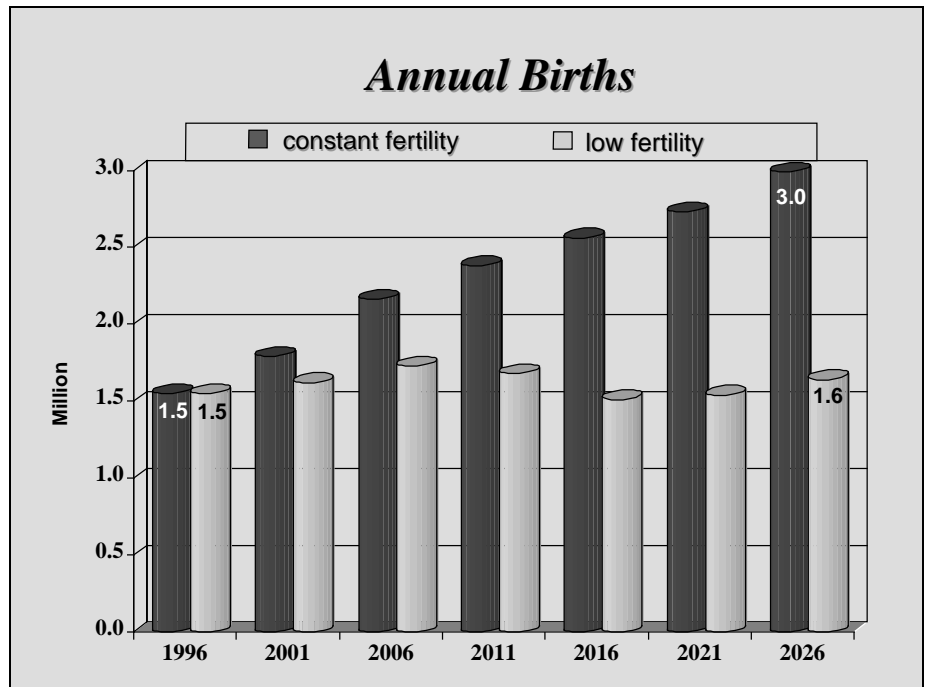
Up until about 1950, the rate of population growth was consistently low, never exceeding 2% per year. Since 1950, however, population growth — as a result of constant fertility and declining mortality — began to consistently exceed 2% per year. Currently, the annual growth rate is about 2.1%.

Natural Growth Rate
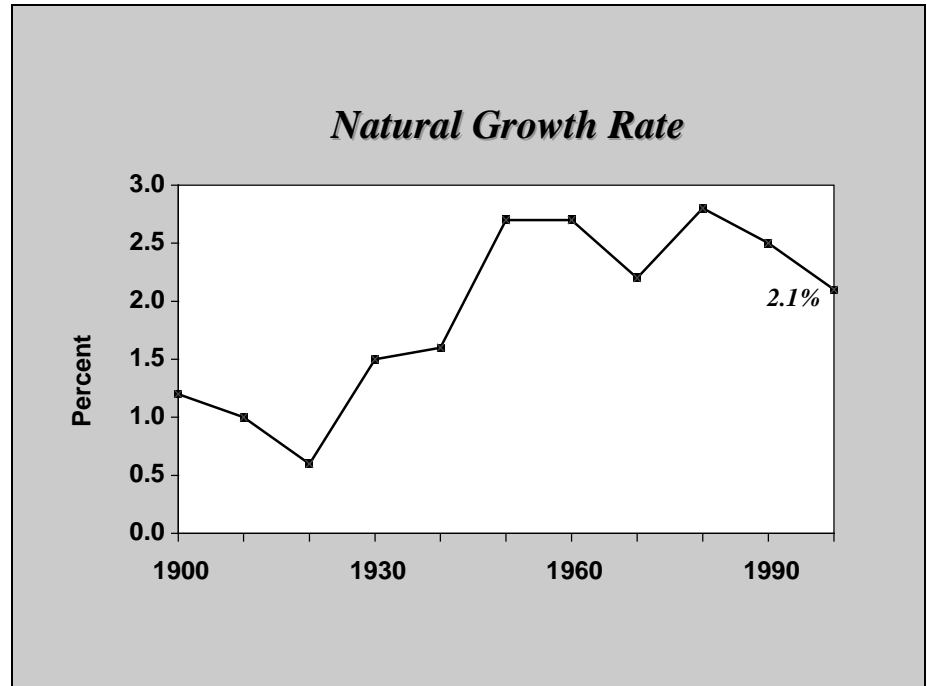
If zero population growth is to be reached eventually, the birth rate must drop to the level of the death rate. The birth rate is closely related to the total fertility rate, which is the number of children that a woman will have in her lifetime.

What are the implications for future population growth if the total fertility rate remains at its current level? To help answer this question, we've constructed two alternative population projections for the next 30 years. The first projection assumes that the present fertility situation is continued. This projection always appears in red. For comparison purposes, we've created a second projection that assumes that replacement-level fertility, about 2.1 children per woman, is achieved by 2015. This projection always appears in yellow. Both projections assume that life expectancy gradually increases over the period, and the rate of net international migration remains low.

In 1996, there were about 1.5 million births in the country. If the total fertility rate of 3.6 children per woman were to remain constant over the next 30 years, the annual number of births would increase from 1.5 million to 3.0 million by the year 2026. Under the low-fertility projection, the annual number of births would be slightly higher from today's levels, rising only to about 1.6 million.

Annual Births

constant fertility low fertility

	1996	2001	2006	2011	2016	2021	2026
constant fertility	1.5	1.75	2.15	2.35	2.55	2.7	3.0
low fertility	1.5	1.6	1.7	1.65	1.5	1.5	1.6

Million

Given the projected number of births under the constant-fertility projection, the total population would grow from 63 million in 1996 to 110 million by the year 2026. While low fertility would lead to fewer births, the population would still increase significantly over the next 30 years, rising to 90 million by 2026.

Total Population
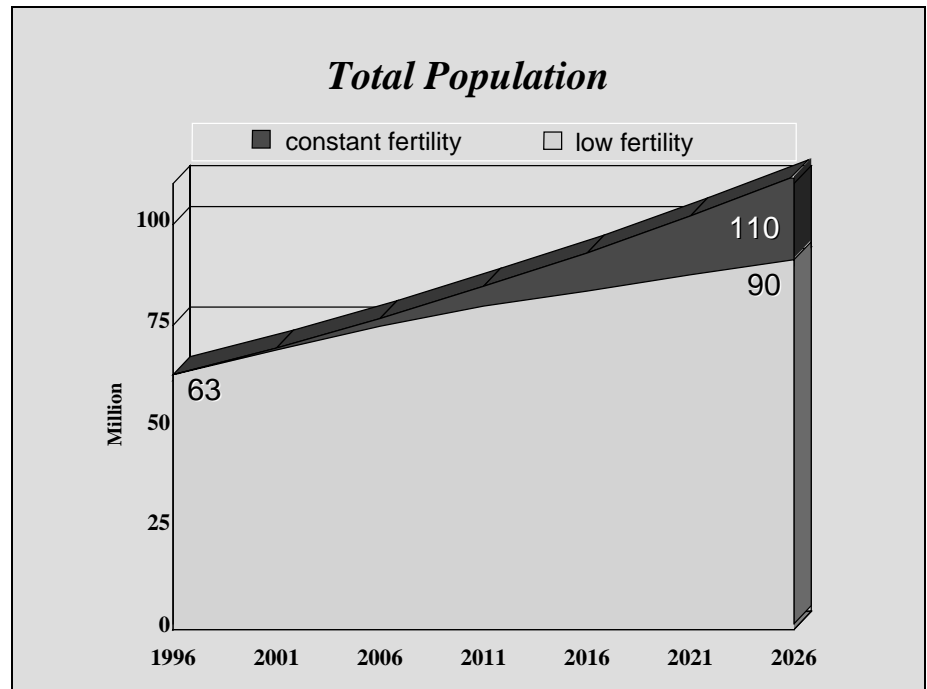
Let's now briefly examine a few of the consequences resulting from the alternative population growth projections in the sectors of: health, the economy, education, urbanisation, water, and the environment.

Health

One of the country's most important development goals is to provide adequate health care for the population. High rates of population growth work against attainment of this goal as scarce health resources are stretched to meet the health needs of ever-increasing numbers of people. In addition, high fertility rates contribute directly to high death rates among both infants and mothers. Infants born closely spaced, to very young women and to very large families — all associated with high rates of fertility — are at a much higher risk of dying.

For example, infants born less than two years apart are more likely to die than those born at least two years apart. The mortality rate for infants born within less than two years of a sibling is about 128 per 1000. When the birth interval is lengthened to two to four years, the infant mortality rate is cut nearly in half, dropping to 47. When the interval extends beyond four years, the infant mortality rate drops to 43. The data clearly show that as the length of the birth interval expands, the infant mortality rate declines.

Infant Mortality Rates

Deaths per 1000

128	

47

43

Birth Interval (Years)

< 2   2-3   4+

This relationship is especially important in Egypt, where a large percentage of births occur at intervals less than two years apart. According to the 1995 Demographic and Health Survey, nearly 26% of all births occurred at intervals less than two years, meaning that about 460,000 infants were exposed to higher rates of mortality associated with shortened birth intervals. If all births in 1995 had occurred at intervals of at least two years, over 20,000 infant lives could have been saved.

High Risk Births

- *26% at intervals < 2 years*
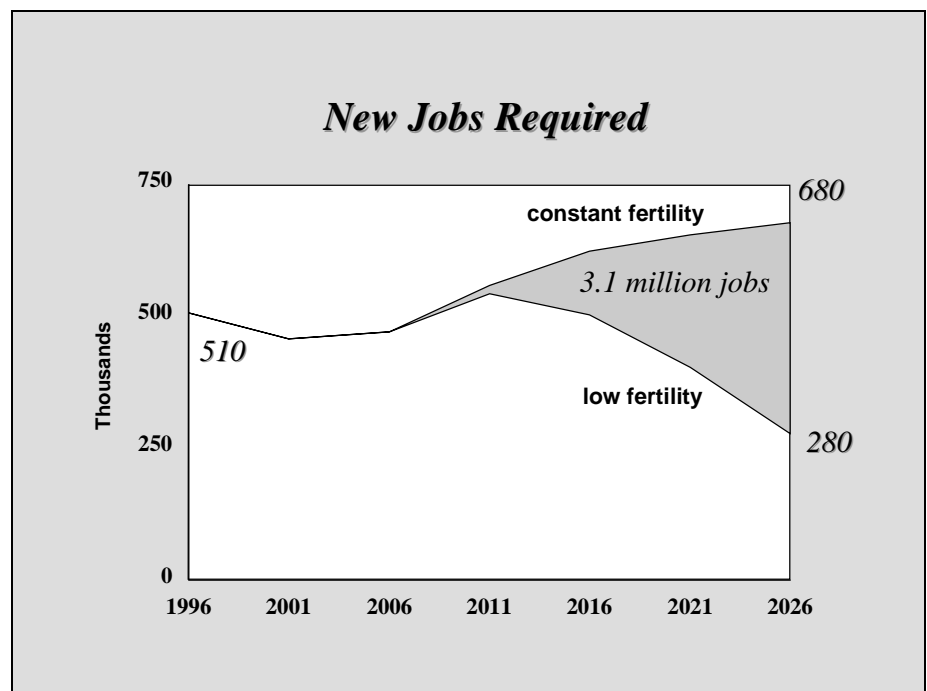- *460,000 infants exposed*
- *20,000 infants lives saved*

Expanding the length of birth intervals allows a mother to devote more time and attention to her infant, and also allows her body more time to recuperate between births. This extra time translates directly into improved health for both the mother and her child, and contributes to the overall well-being of the entire family.

Population growth affects the economy in a number of ways, including per capita income, the size of the labour force, the number of new jobs that have to be created annually, and the dependency ratio.

Economy

Providing jobs for new entrants into the labour force is critically important to maintain economic growth and social stability. Currently, if employment were provided for all new entrants into the labour force, nearly 510,000 new jobs would have to be created each year. If the current level of fertility were to continue, the number of new jobs to be created each year — just to absorb new entrants into the labour force — would increase to 680,000 by the year 2026. By contrast, only 280,000 new jobs would have to be created in 2026 with a reduction in fertility. Over the entire period, 3.1 million fewer jobs would have to be created as a result of achieving a lower population growth rate.

New Jobs Required

	constant fertility
510	3.1 million jobs
	low fertility

Thousands

750   680

500

250   280

0

1996   2001   2006   2011   2016   2021   2026

When ample employment is provided, people are productive, the per capita income increases, and the country develops. Conversely, when large numbers of persons are unemployed, social unrest increases and additional burdens are placed on the government to provide assistance for the unemployed. Clearly, providing sufficient employment opportunities in the future would be easier with lower population growth than if high population growth were to continue.

Education

Another government goal is to provide a quality education for all children. Population growth directly affects the government's ability to achieve this goal as it determines the numbers of teachers, classrooms, books, schools, and educational expenditures needed by the students in the future. Future annual primary education expenditures demonstrate how the education system will need to expand.

Education Expenditures (LE)
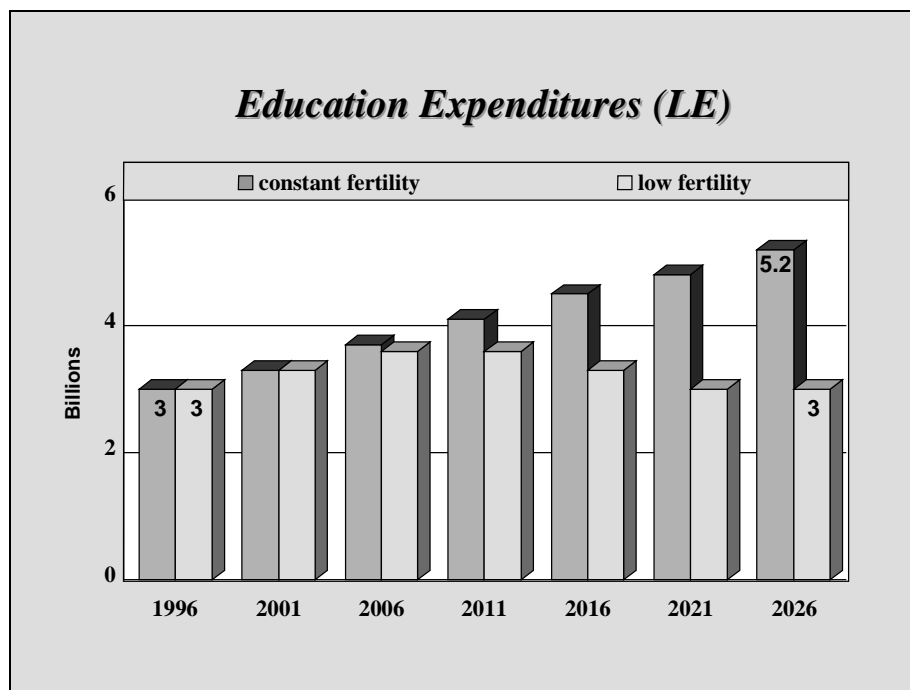
In 1996, about 3 billion pounds were spent on recurrent expenditures for primary education. As the population grows, more money will have to be spent on education just to continue providing the current levels of educational services, let alone improve their quality. Assuming that the primary educational expenditure per student and enrollment rate were to remain constant, annual expenditures on primary education would increase from 3 billion pounds to 5.2 billion pounds by 2026 with high fertility continued. With low fertility, however, annual primary education expenditures in 2026 would be only 3 billion pounds — about the same as today.

Over the entire 30-year period, nearly 25 billion fewer pounds would have to be spent on primary education as a result of lower fertility. These extra funds saved could be used to improve the quality of the education system.

Urbanisation

Growth of Cairo

20 million

10.5 million

3.4 million
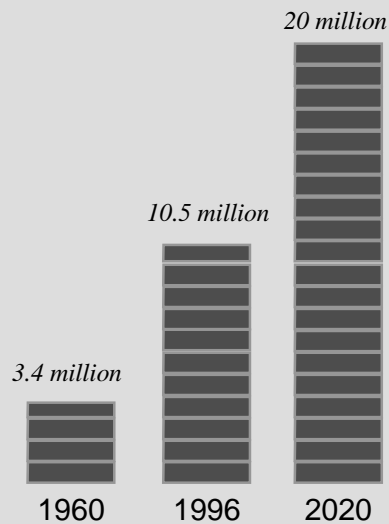
Between 1960 and 1996, Cairo's population grew by over 3% a year.

1960　1996　2020

One of the most visible signs of rapid population growth is the congestion apparent in all urban areas. The effects of urbanisation are clearly evident in Cairo, Alexandria, and other major urban areas. In 1960, Greater Cairo's population was about 3.4 million. In 1996, it was estimated to be 10.5 million.

From 1960 through 1996, the population of Greater Cairo grew at an alarming rate, increasing by over 3% per year. At this rate of growth, the population would double within 23 years, meaning that Greater Cairo's population would reach nearly 20 million persons by the year 2020.

Urban infrastructures are already seriously overtaxed by the burgeoning population, and providing adequate housing, sewerage, electricity, and other services will only become more difficult as the population living in cities continues to grow. Lower population growth rates are critical if Egypt's cities are not to be overwhelmed.
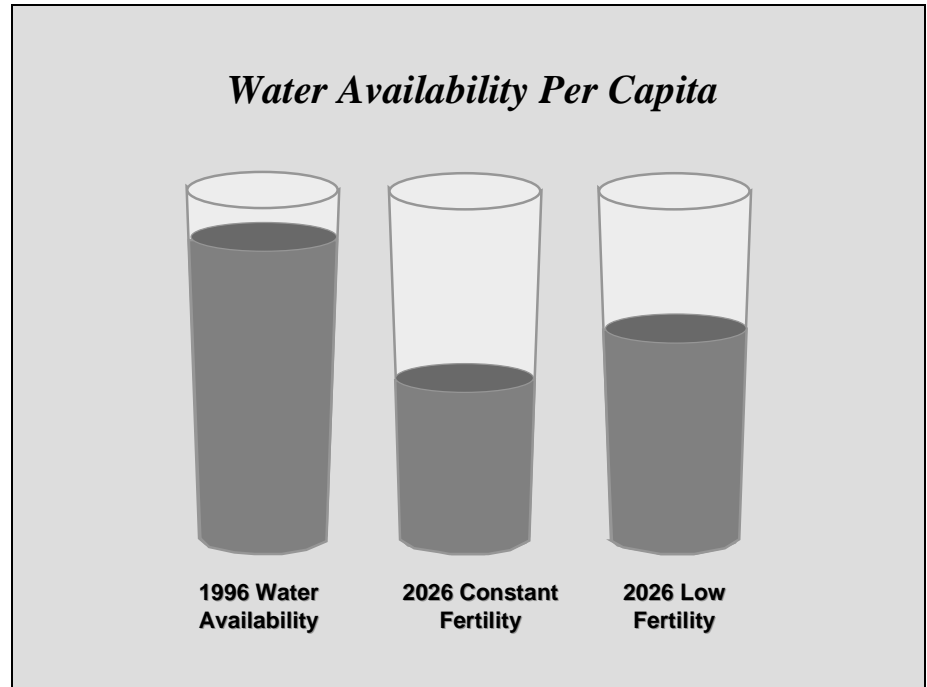

Water

The Nile has always provided the country's lifeblood — water. Water, necessary for drinking, irrigation, and industry is, however, becoming increasingly scarce. A 1996 paper by the Egyptian Center for Economic Studies states that: "....a lack of water may become one of the most serious impediments to the nation's economic development, to say nothing of its negative impact on the quality of life of Egypt's residents."

Population growth will have a significant impact on the amount of water available per person in the future. Assuming that the supply of renewable fresh water were to remain fixed at 60 billion cubic meters per year, with high fertility, the annual

amount of water available per person would be reduced to nearly half of today's levels by 2026 — decreasing by 44%. The amount of water available per person would still decrease with lower fertility, but reducing fertility would allow each person to consume 23% more water per year than if fertility were to remain at current levels.

Water Availability Per Capita

| 1996 Water Availability	2026 Constant Fertility	2026 Low Fertility

Lower population growth rates will help ensure that there will be enough water to help the country continue developing, and will provide a better quality of life for the nation's citizens in the future.
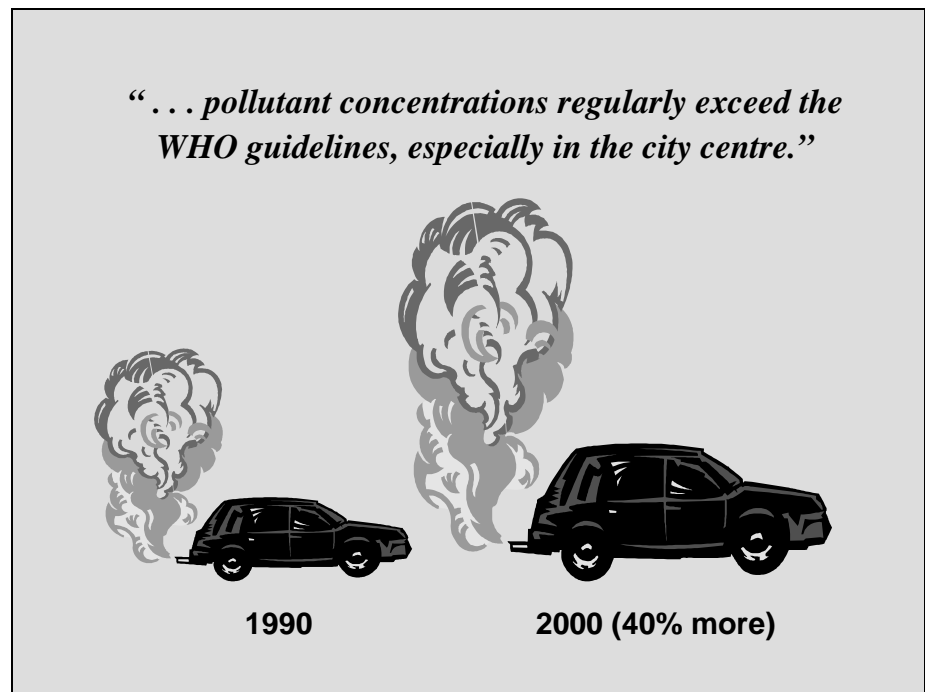
Environment

In the previous example, we assumed that the supply of renewable fresh water would remain fixed. This assumption, however, may be optimistic given the increasing levels of environmental pollution. Environmental pollution, which is greatly affected by increases in the size of the population, is contributing to reductions in the availability and quality of fresh water. Each day, tons of solid waste, pesticides, and other pollutants used by the growing population are dumped into the Nile. And few facilities are available to treat these pollutants. The World Health Organization, or WHO, estimates that 60,000 Egyptians die annually from water-borne diseases.

Environmental Pollution - Water

60,000 deaths annually
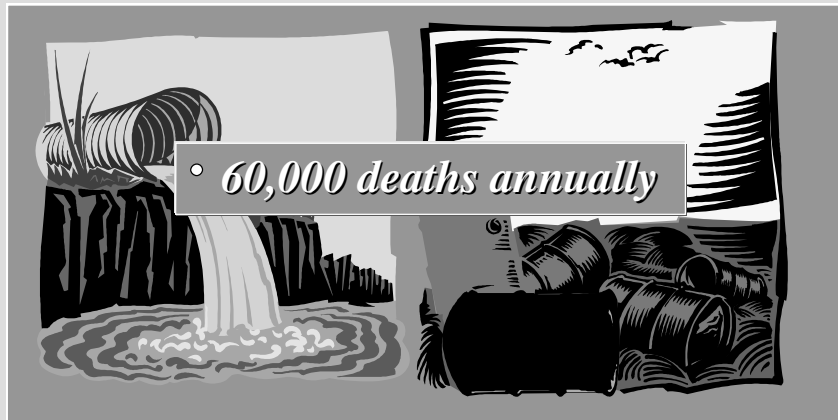
Air pollution is another example of population growth's effect on the environment. The air in urban areas, for example, is deteriorating due to the emissions of additional vehicles required to transport the population. In 1990, it was found that in Cairo, "… pollutant concentrations regularly exceed the WHO guidelines, especially in the city centre." This situation is expected to worsen over the next several years as the population increases. By 2000, the estimated pollution — as measured by carbon monoxide emissions — is expected to increase by 40%.

" . . . pollutant concentrations regularly exceed the WHO guidelines, especially in the city centre."

1990   **2000 (40% more)**

The government is under tremendous pressure to continue providing a habitable environment. Improving technological efficiency, reducing unnecessary consumption, strengthening environmental laws and regulations, and improving sewage treatment are all actions to be implemented. Reducing population growth, however, must be included as part of any comprehensive strategy to maintain a sustainable environment.

We've only examined a few consequences of future population growth. We could examine others, but the idea would remain the same. If the country is to continue on its path of development, it needs to continue its past progress in achieving lower rates of population growth.

How can lower rates of population growth be achieved? Let's turn to the final portion of the presentation and examine actions that can achieve and sustain these lower rates of growth.

In general, the objectives of these approaches are: 1) to provide sufficient and appropriate family planning services to those couples currently desiring them, and 2) to increase the demand for these services. Achieving these objectives will lead to increased contraceptive prevalence and effectiveness; to reduced fertility; and, ultimately, to reduced population growth.

Egypt has been extremely effective in the past in increasing contraceptive prevalence, both by supplying family planning services and by generating demand for their use. These efforts have been instrumental in bringing about a decline in fertility. When the family planning program was started in 1965, contraceptive prevalence was only 7%. From that time, contraceptive prevalence rose steadily until 1991, when it reached nearly 48%. Simultaneously, the total fertility rate dropped from 7 to 3.6 — primarily because of the increase in contraceptive prevalence.

Contraceptive Prevalence and Total Fertility
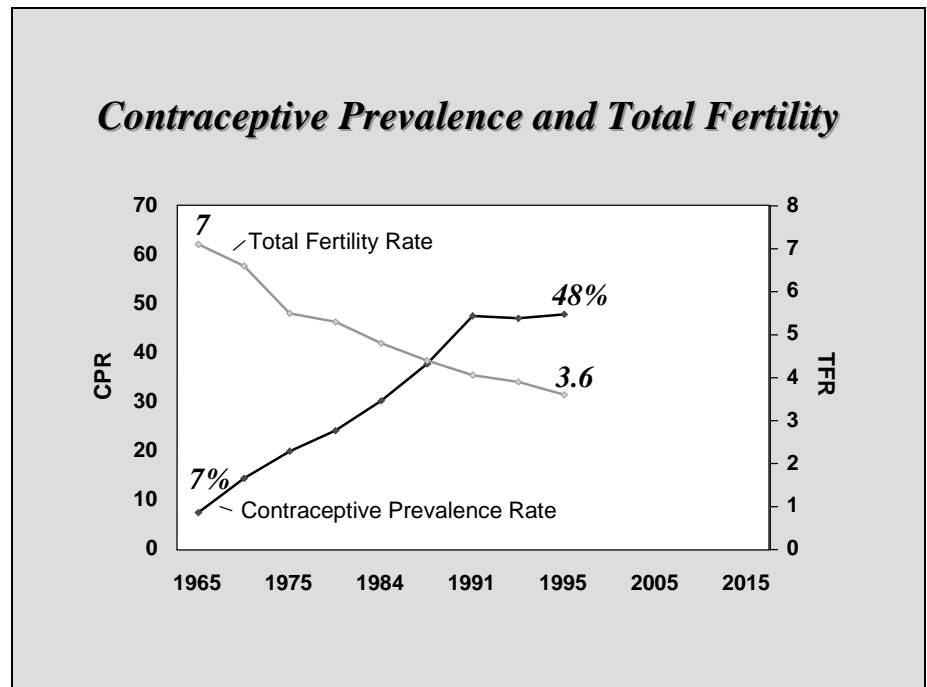
Supply. The family planning program has been extremely successful in providing services to couples desiring them. There remains, however, a significant amount of unmet need for family planning services. (Unmet need is represented by married women who do not want a pregnancy at the current time but are not using any family planning method.)

The total amount of unmet need for family planning services throughout the country is estimated to be about 16%.

Impact of Meeting Demand
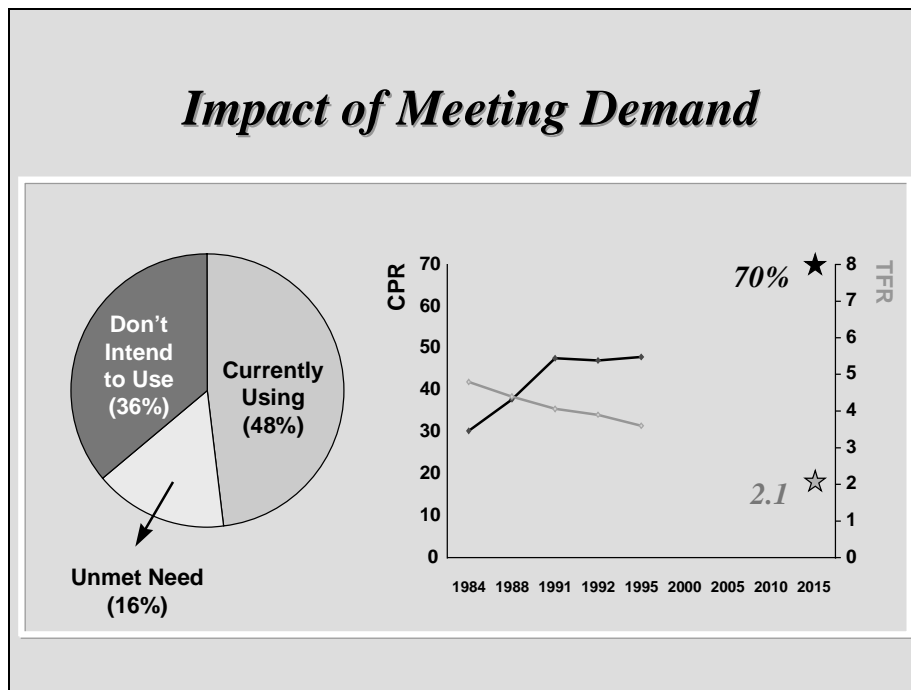
Unmet need is particularly high in rural Upper Egypt. If the family planning program could reach all couples with an unmet need, contraceptive prevalence would increase from 48% to 64% and the total fertility rate would drop to 2.4 children, changes that are significant but still several steps away from the targets of 70% and 2.1 children.

Impact of Meeting Demand
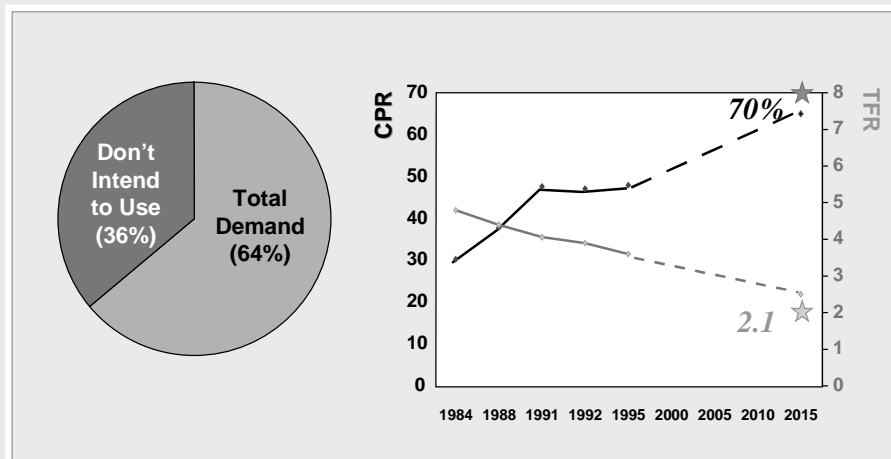
A number of programs are being advanced to enhance the supply of family planning services.

- Efforts are being made to improve the quality and increase accessibility of services by providing clinical training to health-care workers, improving health facilities, and introducing new contraceptive technologies.

- Outreach programs seek to meet the needs of specific under-served groups, such as young women and women in rural Upper Egypt.

- Support for the private sector and nongovernmental organizations, or NGOs, greatly expands family planning coverage while alleviating strain on government services.

- Expanding the scope of services to include reproductive and women's health takes advantage of natural linkages between health care and family planning to reach greater numbers of women.

To significantly increase contraceptive prevalence, however, these efforts need to be intensified. Doing so will require strong political support and a strong commitment of resources.

Demand. Although enhancing the supply of family planning services to satisfy unmet need will significantly reduce fertility, replacement-level fertility cannot be achieved without corresponding increases in demand. Even where high-quality services are readily available, many women do not want to use them because they have a negative image of contraception, or because they desire a large family.

Therefore, the second part of the strategy requires increasing the demand for family planning services. Again, a number of programs are being used to generate new demand, and to strengthen existing demand.

In order to combat negative rumors, intensive communication campaigns seek to provide women with accurate information about contraception and to increase women's interest in using family planning.

- Efforts are being made to increase the active involvement of men in the family planning program.

- Other program efforts employ outreach workers to educate women about family planning, and train clinic workers to counsel women more effectively.

- Research studies enhance understanding of women's needs and concerns and help to design more effective communication strategies.

The status of women is also a very important determinant of contraceptive use. Educated women and women working for cash typically have much higher contraceptive prevalence rates and therefore, lower fertility rates than uneducated women and those not working for cash. For example, women with a secondary or higher education have a contraceptive prevalence rate of 57%, while women with no education have a contraceptive prevalence rate of 41%.

Effects of Female Education

Contraceptive Prevalence


Secondary Education | No Education
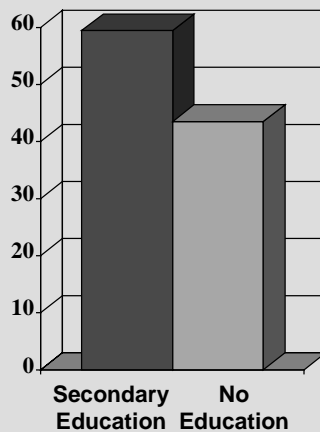
Female education and employment status also reduce fertility by delaying the age at marriage. Women who marry later reduce the total number of years they are reproductively active, and thus have fewer children than women who marry young. Women with a secondary or higher education have a median age at first marriage of 23.7 years, while women with no education have a median age at first marriage of 17.5 years.

Effects of Female Education

Age of Marriage

Secondary Education   No Education
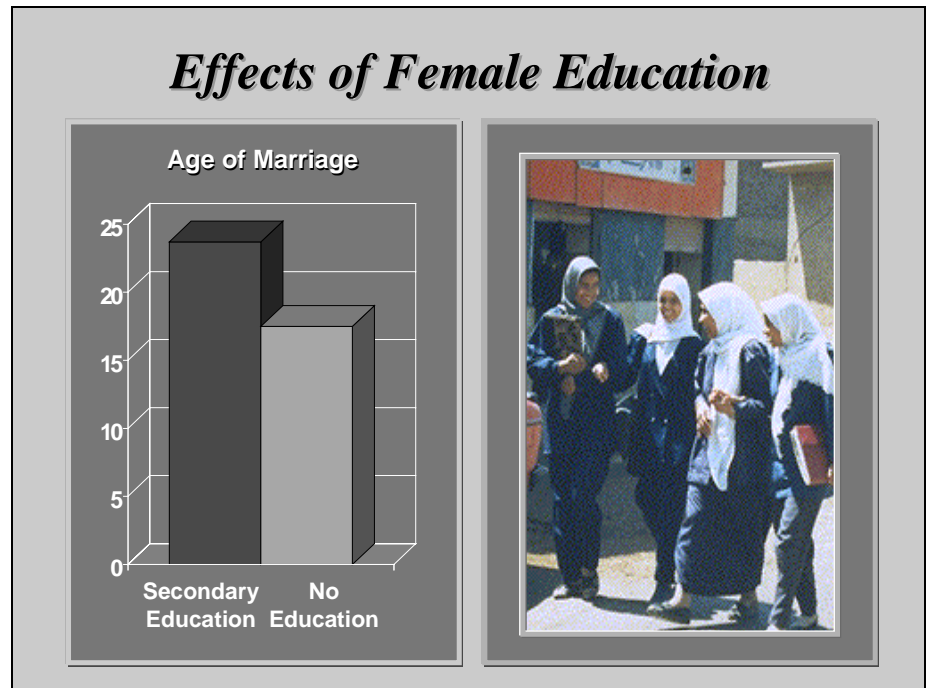
Therefore, promoting girls' education and encouraging women's participation in the formal labour force are key to increasing the demand for family planning services and reducing total fertility rates.

As was mentioned earlier, the total existing demand for family planning services is 64% — a significant increase over the past 30 years. However, if replacement-level fertility — 2.1 children per woman — is to be achieved, contraceptive prevalence must reach 70%. This will require that demand be increased by another 6 percentage points.

Impact of Increasing Demand
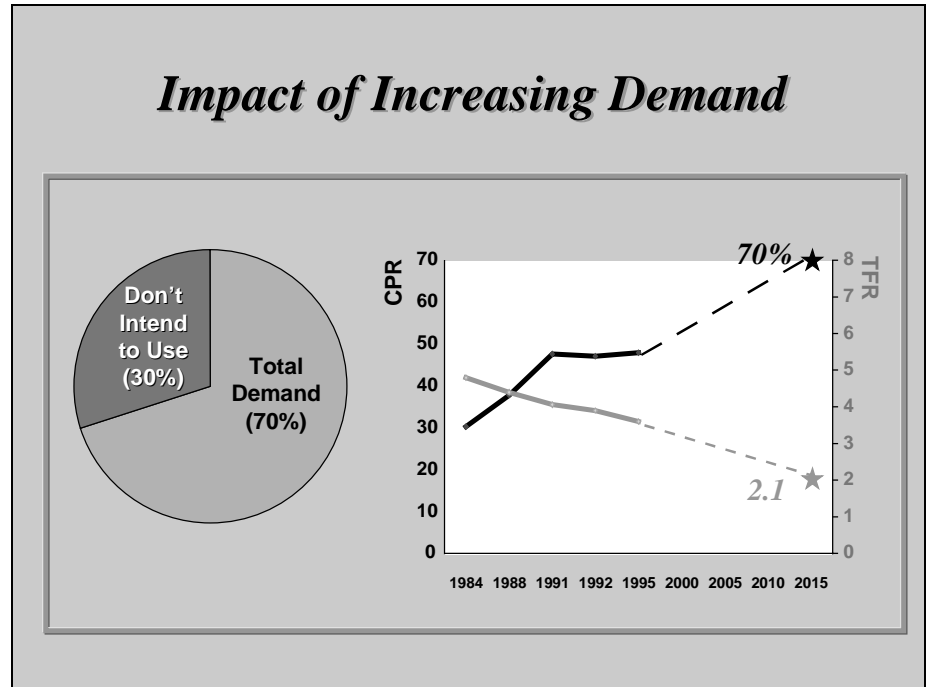
Despite current interventions, many women continue to fear using contraceptives because of false information, and many other women are still poorly educated and have no opportunity to work for cash. Programs must do more to inform women about contraception and to increase educational and employment opportunities if demand for family planning services is to increase.

The reduction in the total fertility rate to 3.6 over the past three decades is commendable. However, there is still more room for improvement, because even at this level of fertility, the implications for the future population are alarming. As we've seen throughout the presentation, population growth, infant and maternal health, and continued social and economic development are directly affected by these high levels of fertility.

In today's presentation, we've examined interventions that can help slow future population growth. The family planning program has been extremely successful in the past, but it must do more if its successes are to continue. The program needs to be strengthened and expanded.

Doing so will require the following actions:

- Adopting and implementing population policies which recognize the importance of population growth and support the use of family planning to reduce that growth;

- Allocating increased levels of financial and human resources to support those policies;

- Increasing the role of the private sector in providing family planning services;

- Improving information messages and communication channels so that all couples throughout Egypt become more educated about family planning methods;

- Increasing the awareness of the importance of family planning on the part of all Egyptians — from the household level to the highest levels of government; and

- Exhibiting strong leadership in support of the program by the country's leaders.

By taking these actions, the country can break out of the current prevalence plateau and the rate of population growth can, once again, resume its decline.
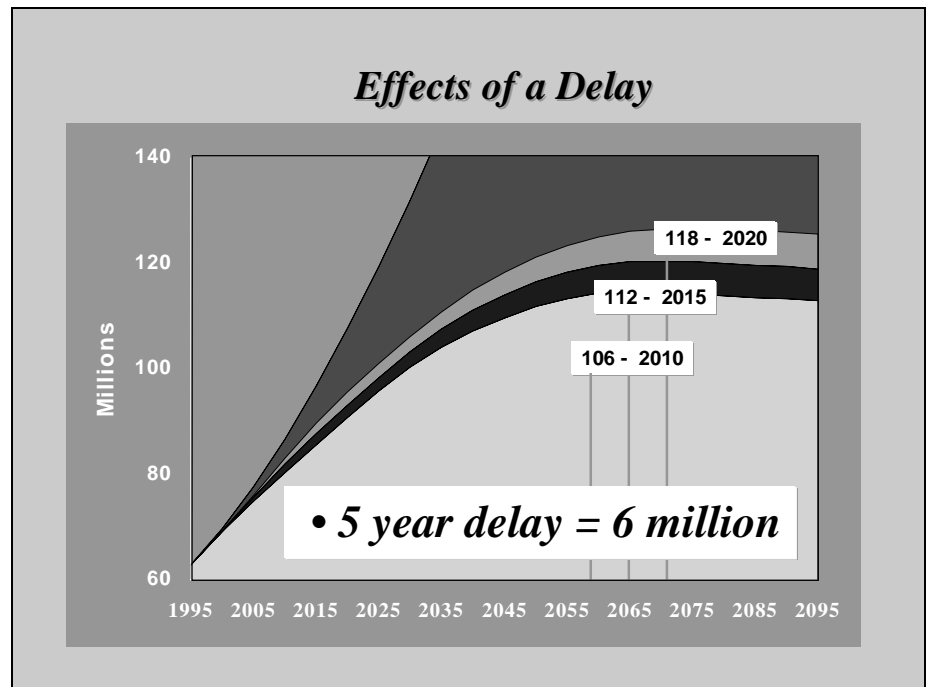
Obtaining financial support in the midst of many competing demands on government resources is one of the most difficult challenges facing the program. It should be kept in mind, however, that while family planning programs are one of the most effective ways to reduce population growth, they are also one of the most cost-beneficial ways for a government to invest its scarce financial resources.

Cost and Benefits of Family Planning Programs

Tunisia	Indonesia	Thailand	Egypt
8.60	12.50	14.00	30.00
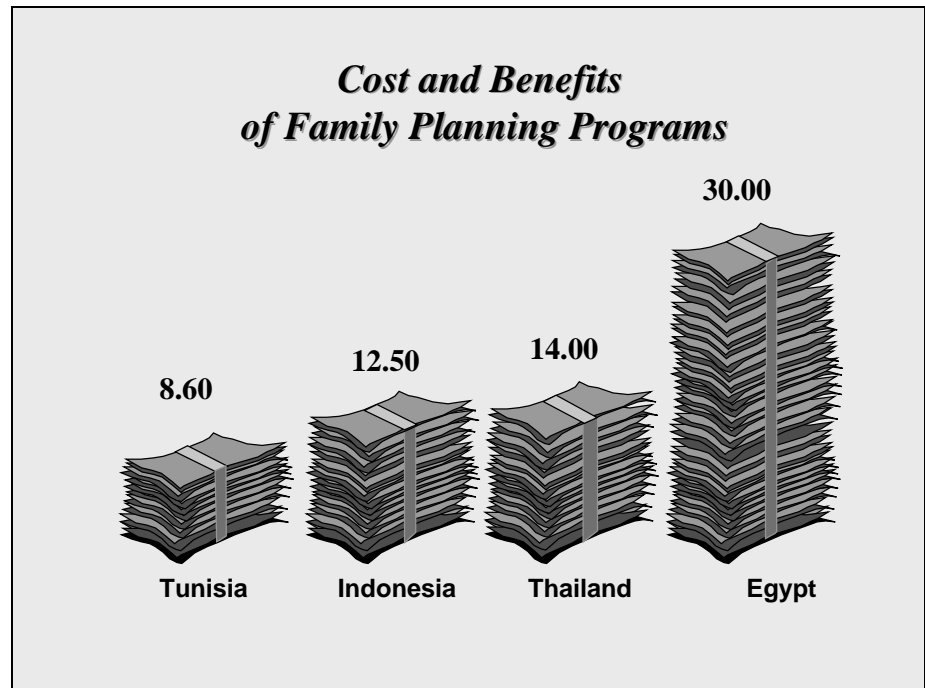
Examples from around the world consistently demonstrate this relationship: every pound invested in family planning in Tunisia yields 8.6 pounds in government savings; every pound invested in family planning in Indonesia yields 12.5 pounds in government savings; and in Thailand, every pound invested in the program yields 14 pounds in government savings. None of these countries' programs, however, compares with the benefits returned through Egypt's family planning program. A study done in 1994 demonstrated that every pound invested in the Egyptian family planning program yields 30 pounds in government savings.

It is imperative to achieve replacement-level fertility, to achieve it quickly, and to begin achieving it immediately. For every one-year delay in achieving replacement fertility, the country's eventual population will be larger. If replacement-

level fertility were reached by the year 2010, the population would eventually grow to 106 million. If replacement levels were reached by 2015 — reflecting the government's goal — the population would eventually grow to 112 million. If replacement levels were reached 5 years later, by the year 2020, the population would grow to 118 million. And we've already seen what will happen if the replacement levels are not achieved. For every five-year delay in achieving replacement-level fertility, the population would eventually be 6 million more.

Effects of a Delay

118 - 2020
112 - 2015
106 - 2010

• 5 year delay = 6 million

Millions

140
120
100
80
60

1995 2005 2015 2025 2035 2045 2055 2065 2075 2085 2095

Egypt has a choice. It can continue its current efforts — which have proven to be successful in the past, although even to maintain its past successes will require some increase in effort; or it can continue its current efforts and actively implement the actions we've presented today. All these actions require your support. If the goal of sustainable development is to be achieved, that support is critical. Egypt's future depends on it.

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